DELHI

SOUVENIR PUBLICATION OF THE INDIAN SCIENCE CONGRESS, 1947

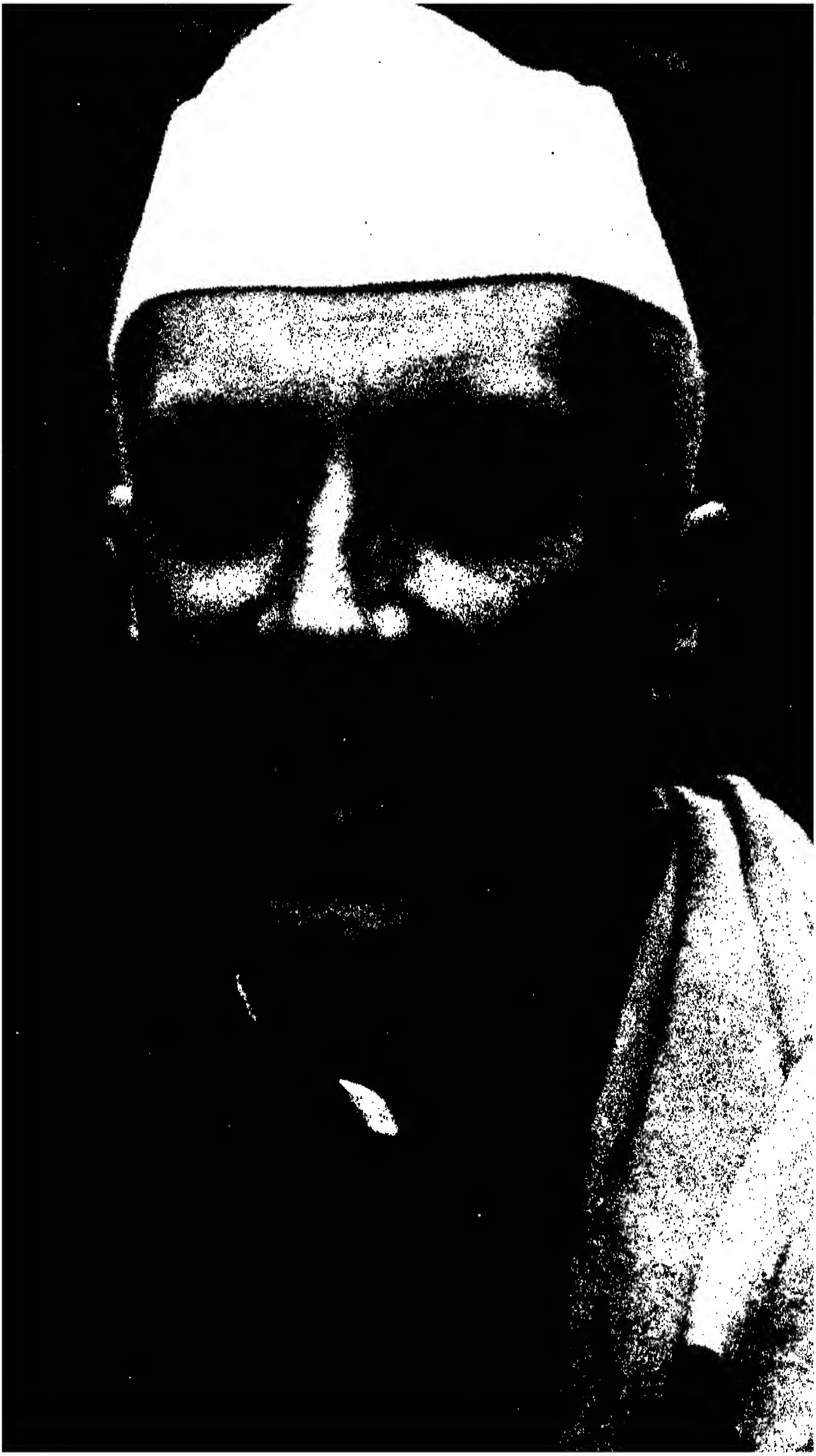
CAMBRIDGE PRINTING WORKS, DELHI.

PREFACE 113723

The cultural and scientific aspects of Delhi form the theme of the present Souvenir. The time available for preparing the volume was short, and this has resulted in the omission of some important institutions in Delhi. Equally serious is the omission of an account of the characteristic aspects of Delhi life. That the present publication has been rendered possible at all is due to the prompt and encouraging response to requests for contributions. General thanks are offered to the institutions and individuals who have generously helped to bring out the Souvenir. Apologies are tendered for the unavoidable omission of a few contributions which could not be accommodated in spite of the best efforts due to shortage of time. The permission given by Messrs. Encyclopædia Britannica Inc., London, for the substantial reproduction of the article on Delhi appearing in the 14th. Edition of the *Encyclopaedia Britannica* is gratefully acknowledged. Thanks are due to the army authorities and the Press Information Bureau for the supply of photographs which punctuate this publication, and to Messrs. Cambridge Press for executing the printing at short notice.

S. B. D.
R. B. P.
B. N. S.

Delhi,
January, 1947.



CONTENTS

← PANDIT JAWAHARLAL NEHRU
President, Indian Science Congress, 1947.

D E L H I—INDIA'S HISTORIC CAPITAL

Delhi, the historic Indian capital, lies on the right bank of the Jumna, practically in the same latitude as the ancient cities of Cairo and Canton. Since the headquarters of the Government of India was transferred from Calcutta to Delhi in 1912, the district around Delhi, formerly a part of the Punjab, has for administrative reasons been constituted a minor province under a Chief Commissioner who is directly subordinate to the Central Government. The ruins of several of the older fortresses (for they were all heavily walled) strew the surrounding country.

Two of them are of special interest, Old Delhi (about 10 miles from the present city), where stand the stately Qutab Minar with the enigmatic Iron Pillar, and Tughlakabad with its titanic walls ; but there is hardly an acre in all the intervening country that does not carry some relic of the historic past. The present city, the seventh of the series, was reconstructed by the Emperor Shahjahan on an older site, and is still known locally as Shahjahanabad. The greater part of it is still confined within his walls. Of its river frontage, about 2¼ miles long, one-third is occupied by the battlements of his palace ; and the complete circuit of the walls is 5½ miles. Shahjahan's original fortifications were strengthened by the British by the addition of a ditch and glacis, after Delhi was captured by Lord Lake in 1803, and its strength was turned against the British in 1857.

The Venue of the Science Congress

The Ridge : Delhi's Ridge has been in existence millions of years before Mount Everest graced Mother Earth. It is a last outcrop of the Aravalli Hills which rises in a steep escarpment some 60 ft. above the city. At its nearest point the Ridge is only 1,200 yds. from the walls of Delhi ; at the Flagstaff tower in the centre of the position it is a mile and a half away ; and at the left near the river nearly two miles and a half. The Ridge is famous as the British base during the seige of Delhi in 1857. The Delhi University buildings are situated beyond the Ridge and comprise the Old Viceregal Lodge.

Reproduced with minor changes with the kind permission of Encyclopaedia Britannica Inc., 90, Dean Street, London. W. 1.

Red Fort

The Imperial Palace (1638-48), now known as the "Red Fort", is disfigured by bare and ugly British barracks, among which are scattered exquisite gems of oriental architecture. The two most famous among its buildings are the Diwan-i-Am or Hall of Public Audience, and the Diwan-i-Khas or Hall of Private Audience. The Dewan-i-Am is a splendid building in the Hindu style, with 60 pillars of red sand-stone supporting a flat roof. It was in the recess in the back wall of this hall that the famous Peacock Throne used to stand, "so called from its having the figures of two peacocks standing behind it, their tails being expanded and the whole so inlaid with sapphires, rubies, emeralds, pearls and other precious stones of appropriate colours as to represent life". Travernier, the French jeweller, who saw Delhi in 1665, describes the throne as of the shape of a bed, supported by four golden feet, 20 to 25 in. high, from the bars above which rose 12 columns to support the canopy. The bars were decorated with crosses of rubies and emeralds, and also with diamonds and pearls, while the columns had rows of splendid pearls. It is estimated that jewels valued at 86 lakhs of rupees and one lakh tolas of gold valued at 14 lakhs, were used. The centre panel on which the Emperor placed his hand before lowering himself to sit, cost 10 lakhs. The whole is valued at £6,000,000. This throne was carried off by the Persian invader Nadir Shah in 1739, and has been rumoured to exist still in the Treasure House of the Shah of Persia ; but Lord Curzon, who examined the thrones there, found nothing except perhaps some portions worked up in a modern Persian throne.

The Diwan-i-Khas is smaller than the Diwan-i-Am, and consists of a pavilion of white marble, in the interior of which the art of the Moguls reached the perfection of its jewel-like decoration. On a marble platform rises a marble pavilion, the flat-coned roof of which is supported on a double row of marble pillars. The inner face of the arches, with the spandrils and pilasters which support them, are covered with flowers and foliage of delicate design and dainty execution, crusted in green serpentine, blue *lapis lazuli* and red and purple porphyry ; the ravages of time were repaired as far as possible by Lord Curzon.

The Chandni Chauk

"Silver Street", which was once supposed to be the richest street in the world, has fallen from its high estate, though it is still a broad and imposing avenue with a double row of trees running down the centre. During the course of its history it was four times sacked, by Nadir Shah,

Timur, Ahmad Shah and the Mahrattas, and its roadway has many times run with blood. The jewellers and ivory workers now dwell there.

A short distance south of the Chandni Chauk the *Jumma Musjid*, or great mosque, rises boldly from a small rocky eminence. It was erected in 1648-50, two years after the royal palace, by Shah Jahan. Its front court, 450 ft. square, and surrounded by a cloister open on both sides, is paved with granite inlaid with marble, and is approached by a magnificent flight of stone steps. The mosque itself is paved with marble, and three domes of white marble rise from its roof, with two tall minarets at the front corners. Two other mosques in Delhi deserve passing notice, the Kala Musjid or Black Mosque, which was built about 1380 in the reign of Feroz Shah, and the Moti Musjid or Pearl Mosque, a tiny building added to the palace by Aurangzeb, as the Emperor's private place of prayer.

Other Monuments

Among the great multitude of historical relics lying to the south and the south west of the city is *the tomb of Humayun*, the second of the Mogul dynasty, a noble building of rose coloured sandstone inlaid with white marble. It lies about 3 miles from the city, in a terraced garden, the whole surrounded by an embattled wall, with towers and four gateways. In the centre stands a platform about 20 ft. high by 200 ft. square, supported by arches ; and above it rises the mausoleum, also a square, with a great dome of white marble in the centre. About a mile to the west is another burying-ground, or collection of tombs and small mosques, some of them very beautiful. The most remarkable is the little chapel in honour of a celebrated saint, *Nizam-ud-din*, near whose shrine the members of the imperial family, up to the time of the Indian Revolt of 1857, lie buried each in a small enclosure surrounded by lattice-work of white marble.

The Qutab Minar, regarded as one of the most perfect towers in the world, was begun by Qutab-ud-din Aibak about A.D. 1200. The two top storeys were built by Feroz Shah. It consists of five storeys of red sandstone and white marble. The purplish red of the sandstone at the base is finely modulated, through a pale pink in the second storey to a dark orange at the summit, which harmonizes with the blue of an Indian sky. Dark bands of Arabic writing round the three lower storeys contrast with the red sandstone. The height of the column is 238 feet. The plinth is a polygon of 20 sides. The basement storey has the same number of faces formed into convex flutes which are alternately angular and semicircular. The next has semicircular flutes, and in the third they are all angular. Then rises a plain storey, and above it soars a partially fluted storey, the shaft of

which is adorned with bands of marble and red sandstone. A bold projectional balcony, richly ornamented, runs round each storey. After six centuries the column is almost as fresh as on the day it was finished.

Nearby are the remains of a mosque erected by Qutab-ud-din immediately after his capture of Delhi in 1193. The design of this mosque is Mohammedan, but the wonderfully delicate ornamentation of its western facade and other remaining parts is Hindu. In the inner courtyard stands the Iron Pillar, dating from about A.D. 400. It consists of a solid shaft of wrought iron some 16 inches diameter and 23 feet 8 inches in height, with an inscription eulogizing Chandragupta Vikramaditya. It was brought here, possibly from Behar, by Anang Pal, a Rajput chief, who erected it in 1052.

The population of Delhi and New Delhi is estimated to exceed 10,00,000. According to the census of 1922 the population of Delhi was 3,04,420. The city is the converging point of a number of railways and occupies a central position, being 940 miles from Karachi, 950 miles from Calcutta, and 960 from Bombay. Owing to the advantages it enjoys as a trade centre, Delhi is recovering much of the prominence which it lost at the time of the Indian Revolt of 1857. It has a number of busy factories, and famous hand industries in gold and silver filigree work and embroidery, jewellery, muslins, shawls, glazed pottery and wood carving.

The Province of Delhi has an area of 573 square miles. It consists of a strip of territory on the Jumna river which formed part of the old Delhi district, and of 65 villages on the opposite bank which were formerly in the Meerut district of the United Provinces. It is an enclosure created for administrative convenience, as a consequence of the new capital. When the emperor was taken under the protection of the East India Company in 1803, the districts of Delhi and Hissar were assigned for the maintenance of the royal family, and were administered by a British Resident. In 1832 the office of the Resident was abolished, and the tract was annexed to the North Western Provinces. After the Indian Revolt in 1857 it was separated from the North Western Provinces and annexed to the Punjab. The old Division of Delhi has its headquarters now in Ambala.

History

According to legend Delhi has from time immemorial been the site of a capital city. The earliest knowledge of Delhi is obtained from the *Mahabharata* and pertains to the epic period of Hindu India, but some

scholars have surmised that Delhi may be older still, reaching back to the Indus Valley civilization. There is a good deal of circumstantial probability connecting Delhi with Indraprastha, the capital of the Pandavas, the traditional site of which is that now occupied by Purana Quila, and the space between it and Humayun's tomb. Delhi was no more than a provincial city under the Mauryas and succeeding dynasties.

The next definite traces of Delhi, however, dates no further back than the 11th century A.D., when Anangapala (Anang Pal), a chief of the Tomara Clan, built the red fort, in which the Kutab Minar now stands. In 1052, the same chief removed the same Iron Pillar from its original position, probably at Muttra, and set it up among a group of temples of which the materials were afterwards used by the Muslims for the construction of the great Qutab Mosque. About the middle of 12th Century the Tomara dynasty was overthrown by Vigraha-raja, the Chauhan king of Ajmere. His nephew and successor was Prithvi-raja, the last Hindu ruler of Delhi. In 1191 came the invasion of Mohammad of Ghor. Defeated on this occasion Mohammad returned two years later, overthrew the Hindu and captured and put to death Prithvi-raja. Delhi became henceforth the Capital of Mohammadan Indian empire, Kutab-ud-din (the general and slave of Mohammad of Ghor) being left in command. The dynasty retained the throne till 1290, when it was subverted by Jalal-ud-din Khilji. The house of Khilji came to an end in 1321, and was followed by that of Tuglak. Ghias-ud-din Tuglak erected a new capital about 4 miles farther to the east which was called Tuglakabad. The ruins of his fort remain. Ghias-ud-din was succeeded by his son Mohammad bin Tuglak, who reigned from 1325 to 1351. Under this monarch the Delhi of the Tuglak dynasty attained its utmost growth. His successor Ferozshah Tuglak, transferred the capital to a new town, Ferozabad, which he founded some miles away. In 1398, during the reign of Mohummed Tuglak, occurred the Tartar invasion of Timurlane. The king fled to Gujarat, his army was defeated under the wall of Delhi and the city surrendered. At length Mohummed Tuglak regained a fragment of his former kingdom, but on his death in 1412, the family became extinct. He was succeeded by the Sayyid dynasty, which held Delhi and a few miles of surrounding territory till 1444, when the house of Lodi supervened and Agra became the capital. In 1526 Babar, sixth in descent from Timurlane invaded India, defeated and killed Ibrahim Lodi at the battle of Panipat, entered Delhi, was proclaimed emperor and finally put an end to the Afghan empire. Babar's capital was at Agra, but his son and successor, Humayun, removed it to Delhi. In 1540, Humayun was defeated and expelled by Sher Shah, who entirely rebuilt the city,

enclosing and fortifying it with a new wall. In 1555 Humayun with the assistance of Persia, regained the throne, but he died within six months and was succeeded by his son, the illustrious Akbar.

During Akbar's reign and that of his son Jehangir, the capital was either at Agra or at Lahore, and Delhi once more fell into decay. Between 1638 and 1658, however, Shahjahan rebuilt it. In 1707 came the decline. Insurrections and civil wars on the part of the Hindu tributary chiefs, Sikhs and Mahrattas broke out. Aurangzeb's grandson Jahandar Shah, was in 1733, deposed and strangled after a reign of one year, and Farrakhsiyiar the next in succession, met with the same fate in 1719. He was succeeded by Mohammed Shah, in whose reign the Mahratta forces first made their appearance before the gates of Delhi, in 1736. Three years later the Perisan monarch Nadir Shah, after defeating the Mogul army at Karnal, entered Delhi in triumph. For fifty-eight days Nadir Shah remained in Delhi, and when he left he carried with him great treasure.

In 1771 Shah Alam, the son of Alamgir II was nominally raised to the throne by Mahrattas, the real sovereignty resting with the Mahratta chief, Sindhia. An attempt of the puppet emperor to shake himself clear of the Mahrattas, in which he was defeated in 1777, led to a permanent Mahratta garrison being stationed at Delhi. From that date, the king remained in the hands of Sindhia until on the 8th of September 1803, Lord Lake overthrew the Mahrattas under the walls of Delhi, entered the city, and took the king under the protection of the British. Delhi, once more attacked by a Mahratta army under the Mahratta chief Holkar in 1804, was gallantly defended by Col. Ochterlony, the British Resident, who held out under overwhelming odds for eight days, until relieved by Lord Lake, and the city, together with the Delhi territory, passed under British administration.

Fifty-three years of quiet prosperity for Delhi were brought to a close by the Indian Revolt of 1857. By the 20th of September the entire city and palace were occupied by the British and the reconquest of Delhi was complete. During the siege, the British force sustained a loss of 1,012 officers and men killed, and 3,827 wounded. On receiving a promise that his life would be spared, the last of the House of Timur surrendered to Major Hodson; he was afterwards banished to Rangoon. Delhi, thus reconquered by the British remained for some months under military authority. The city was made over to the civil authorities in January 1858, but it was not till 1861 that the civil courts were regularly reopened. Since that date Delhi has settled down as a prosperous commercial town and a great railway centre.

New Delhi

Its establishment was first announced in 1911. It has been designed and built as a capital for all India. Its site, is on the great alluvial plain of the Jumna, sloping slightly from west to east. Its centre in the Great Place at the foot of the rock on which stand the main government buildings is about 5 miles to the south of Shah Jahan's fort in Old Delhi. The site was chosen in 1912. The planning of the city was entrusted to Sir Edwin Lutyens after an agreement had been come to with Lord Hardinge that the main government building should be placed on the rock to which reference has been already made. This rock is a spur of the main Delhi Ridge and like it consists of very hard quartzite. It stood some 50 ft. above the plain, but the top 20 ft. have been blasted off to make a level plateau for the great buildings and to fill in depression.

With this low acropolis as the focus of the city, a very original city plan has been laid out as large in scale and covering a larger area of organised planning than Washington (D. C.). The central mall and the diagonal avenues may owe something to L' Enfant's plan for that city, as well as something to Sir Christopher Wren's plan for London after the Great Fire, but the total result is quite different.

It is a plan based on a series of large hexagons closed by a semi-circular road to the west where the site is bounded by the Ridge. This plan, with its wide central processional road and its diagonals at 30° and 60°, brings into vista all the chief landmarks of the flat landscape. The main axis leads to the old walled city of Indraprasth, while one avenue is focussed on the great mosque or Jumma Musjid in Old Delhi, forming an absolutely direct route to that town, and another on the lofty tomb of the emperor Humayun. Subsidiary avenues lead to other monuments. In this way the new city is not only related to the Delhis of the past which surround it but emphasizes its peaceful and all-embracing character in distinction to their encircling walls and fortifications. In detailed planning the roads are in three classes, 150 ft., 120 ft., and 76 ft. wide, lined with one, two or even three avenues of trees. The central mall has continuous canals of water as well. Where main roads intersect there are great round turning points showing an appreciation in the plan of the needs of motor traffic several years before that traffic had anywhere developed.

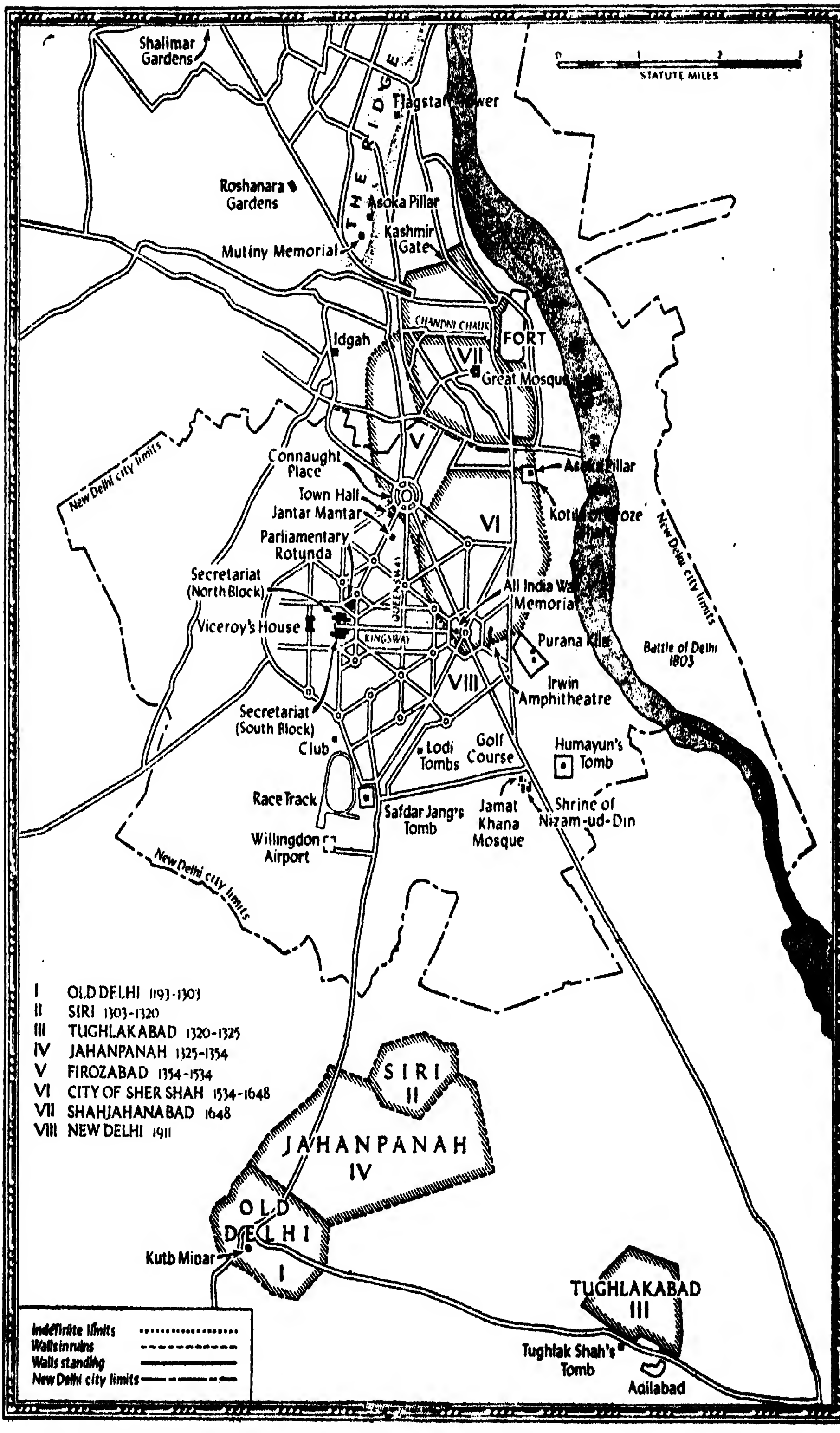
The filling in of the plan has provided residential sites of varying importance. The Princes of India have built their palaces in the great circular roads round the triumphal arch to the Indian armies which closes the main processional way. Along the main axis are sites for

Government buildings and for the residences of members of council. Along the lesser avenues are residences for officials, and hostels for members of the Assembly. In other areas are chummeries and bungalows for clerks, circles of shops and other necessary commercial buildings.

The new city already held 80,000 people in 1937 on the site which was originally planned to receive a smaller number. All this building is in brick covered in stucco white-washed every year after the rains. The general form of expression is a simplified form of Palladian classic. This has meant nearly everywhere long horizontal lines of classical porticoes having their deep shadows contrasted with the plain white wall surfaces, the whole set in lawns and surrounded with trees and flowering shrubs. The result is a garden city and in a more just sense than the term is generally used. Seen from the Ridge, the city is a sea of trees (all of which have had to be planted and have water-pipes laid to them), through which long, low, white classical buildings glint.

The main buildings on the acropolis of rock form the climax of the town and overlook the plain of bungalows, trees and magnificient roads. These are three, the two great secretariat buildings designed by Sir Herbert Baker which line the processional way, and Government House, the palace of the Viceroy, designed by Sir Edward Lutyens, to which this great avenue leads. The big legislative building is situated on the plain at the foot of the rock on the axis of the road from Old Delhi and is a great circular structure by Sir Herbert Baker with a continuous open colonnade, half a mile in circumference. It contains the three chambers, one for the assembly, one for the council and one for the ruling princes grouped round a central library large enough to hold a meeting of the members of all three. This library chamber will go down in history as the meeting-place of the Constituent Assembly which has begun its work. The circular form of the legislative building was dictated partly by political reasons and partly by the triangular space on which it is situated between three roads. It is hoped that some day a circular structure on a similar triangular site on the opposite side of the main axis may house supreme courts of justice for all India.

The two secretariat buildings are in the main Italian structures and present to the processional way four projecting blocks in pairs each carrying a portico of columns with recessed courts between. The idea of these projections is apparently to stand out like sentinels on the great approach. Crowning the recessed building in the centre on either side is a tall Italian dome on a drum. All these features, tall and important in



Delhi through the Ages.

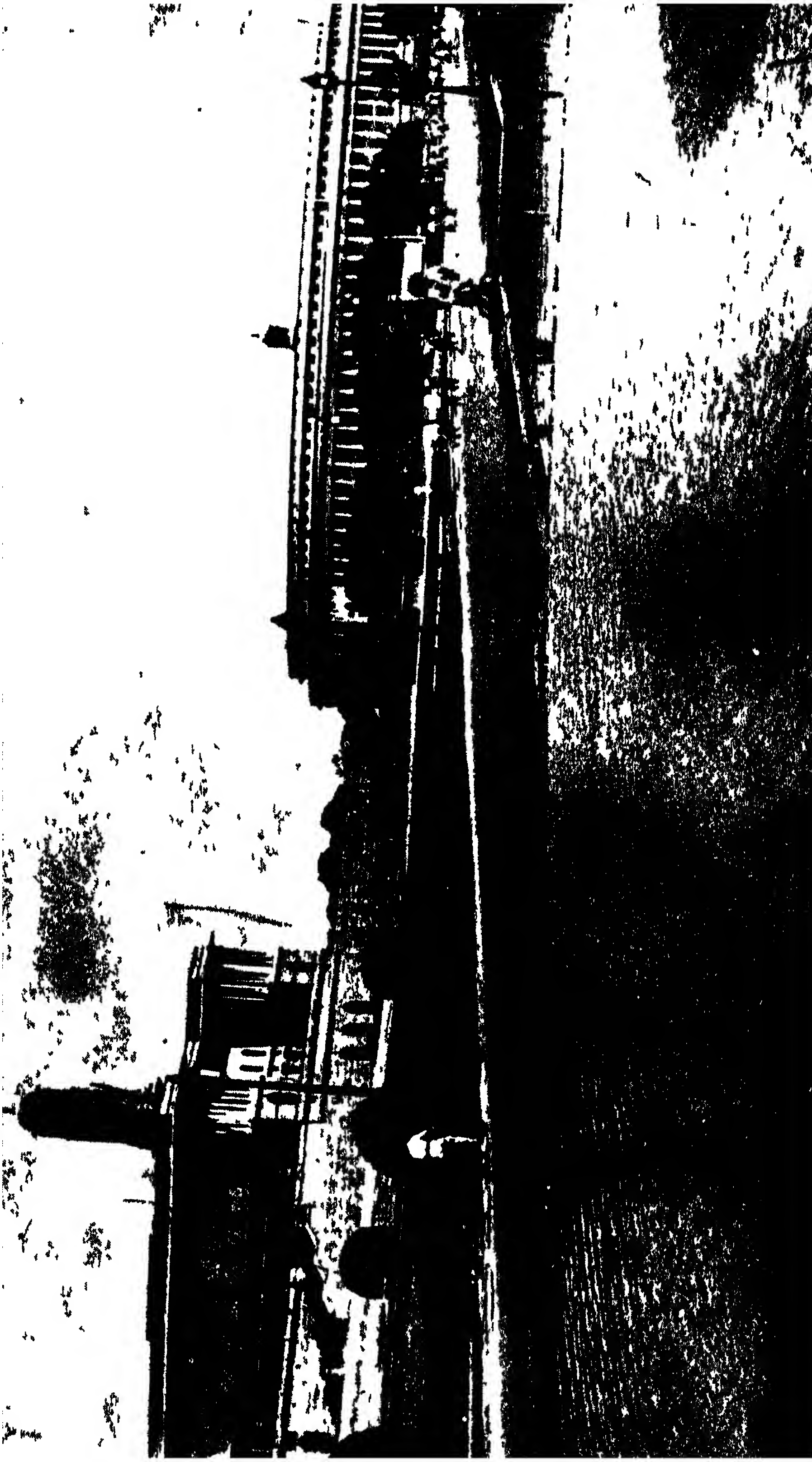
themselves, together with the towers which rise from the end blocks and face down the canal, being in pairs about the main axis form the approach to the palace set back behind its forecourt and itself crowned with a great dome.

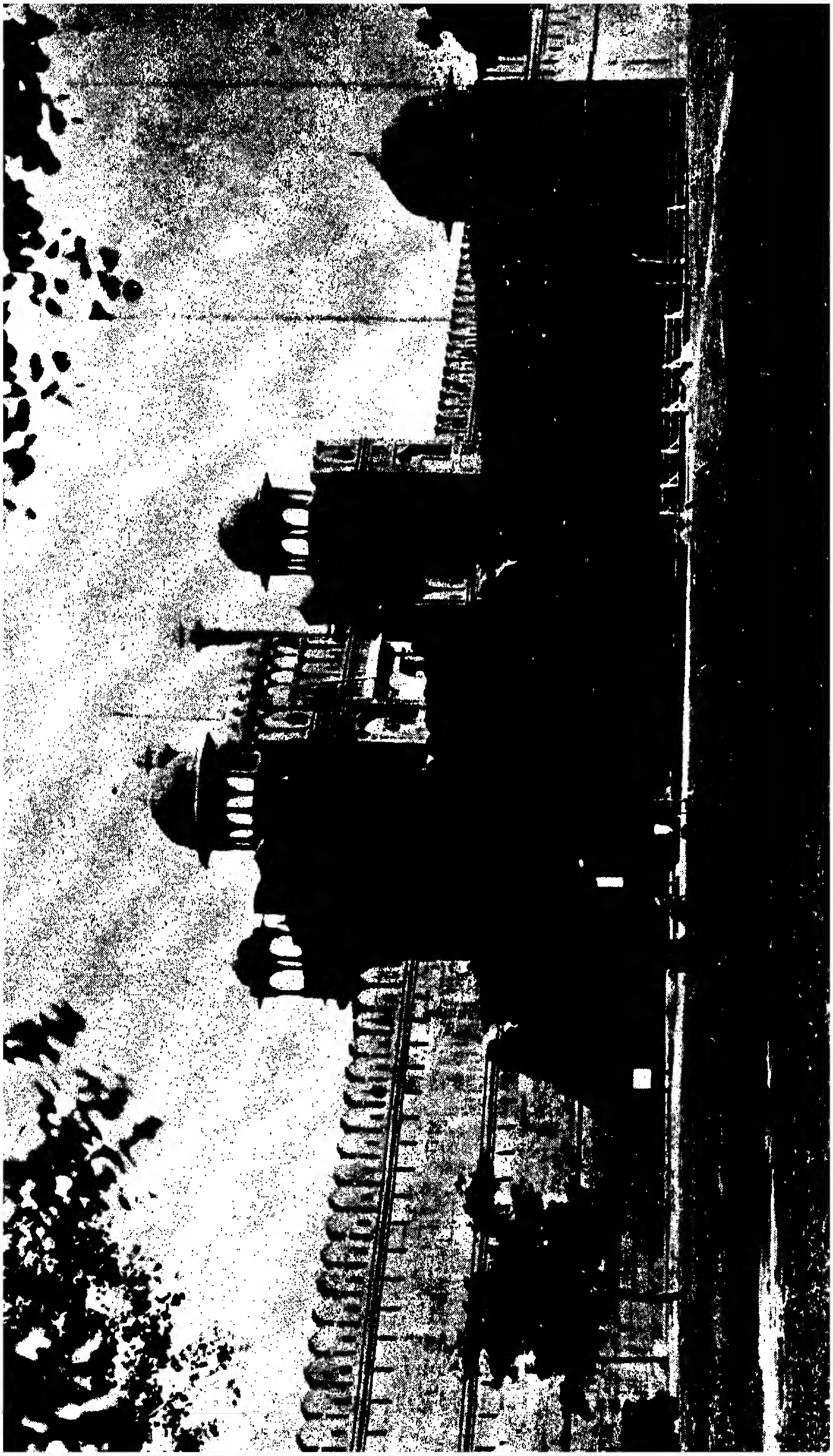
All these four great buildings, together with their steps, terraces and surrounding walls, are in red sandstone to the base of the columns and in white above, brought by a specially constructed railway from the States of Bharatpur and Dholpur, some 80 miles away. Two to three thousand masons were employed continually on the work. The form of architectural expression used throughout is Palladian classic but the architects have introduced Indian features such as the Chajja or projecting stone slab to keep walls cool, the Chhattri or umbrella shaped roof—Indian symbol of royalty—the Jaalis or pierced stone grills. The design of the Government House goes farther than that of the secretariat buildings in the effort to marry the spirit of Indian Architecture, both Hindu and Mohammedan, to that of English and Italian classic. Because the spirit of Indian detail as far as compatible with European classical motifs has been absorbed rather than its forms copied, new and interesting character, which nevertheless seems harmonious and inevitable, has resulted.

Jantar Mantar—This is the name of a group of astronomical buildings situated within New Delhi though they strictly belong to the older city. The rustic name "Jantar Mantar" is an alliterative corruption of "Samrat Yantar". This group of buildings was erected by Maharaja Jai Singh II of Jaipur. A number of such observatories were erected by the same Maharaja at Muttra, Benares and elsewhere. Astronomical tables based on observations taken at all these places excelled in accuracy any then known, and are used in India to this day by many astrologers. In the Jantar Mantar are a masonry gnomon, with a marble dial, a small altitude meter, and two round amphitheatres in which directions and heights of stars could be observed.

So we reach the end of a brief survey of Delhi. A new period has begun in the long vista of Delhi's history, and we stand gazing once more into the mists of futurity. Delhi, today, is more significant in the national life than ever before "for the importance of Delhi is founded on more than the presence of a court or an army; it rests upon its great public buildings which cannot be lightly abandoned, its easy communications with all parts of the country, its geographical position which all historical experience has confirmed, and finally upon the accumulated sentiment of centuries. and the mounting aspirations of Indian nationalism".

The Secretariat Buildings, with a portion of the Council Chamber to the right →





DELHI'S POST-WAR DEVELOPMENTS

by

Mr. G. C. DORSETT

When New Delhi was planned for construction beside the old city of Delhi, two separate cities became friendly neighbours as though there was a distinct dividing line between the two. This may have been due to the fact that the old city of Delhi was a walled city but now there is an opportunity for the two cities to unite and become one. This is possible because of the Government of India's plans for post-war development throughout the country. Delhi is to share in these post-war developments and schemes for improvement costing 6½ crores of rupees have been formulated and are now being worked out in detail.

One of the important developments which will help to make Delhi one city is the scheme of the Delhi Improvement Trust to start clearing the slums between the Delhi Gate and the Ajmeri Gate. One of first things to be done in this connection is to demolish the south wall of the old city which for so long has prevented fresh air from getting to the inhabitants of that part of the town and has also helped to hide the dirt and dilapidated buildings that choke the area within the wall's perimeter. When the wall is removed the gates will be left as a link with the past but the new buildings which will arise there will most likely blend harmoniously with the buildings of New Delhi, thus a big step forward to the union of the two cities will be made through this single action. In this connection it is proposed that the Minto Road shall eventually be extended right through to the Jumma Masjid giving a new main thorough-fare between Delhi City and New Delhi. In addition to this method of uniting the two cities there is also a possibility of a corporation being formed that will operate not only for New Delhi and Delhi city but will also link up the various Notified Areas etc., so that if a corporation is formed, the union will thus become complete.

The post-war developments are not to be limited to Delhi urban area alone but the whole of the province is to receive the benefit of carefully prepared schemes. Already most of the plans have been fully worked out and a number of schemes have been put into operation. Many schemes are to be started in 1947 and adequate budget provision is being made to ensure the rapid development of the work on the plans now ready for execution. Amongst the most important are the Medical and Public

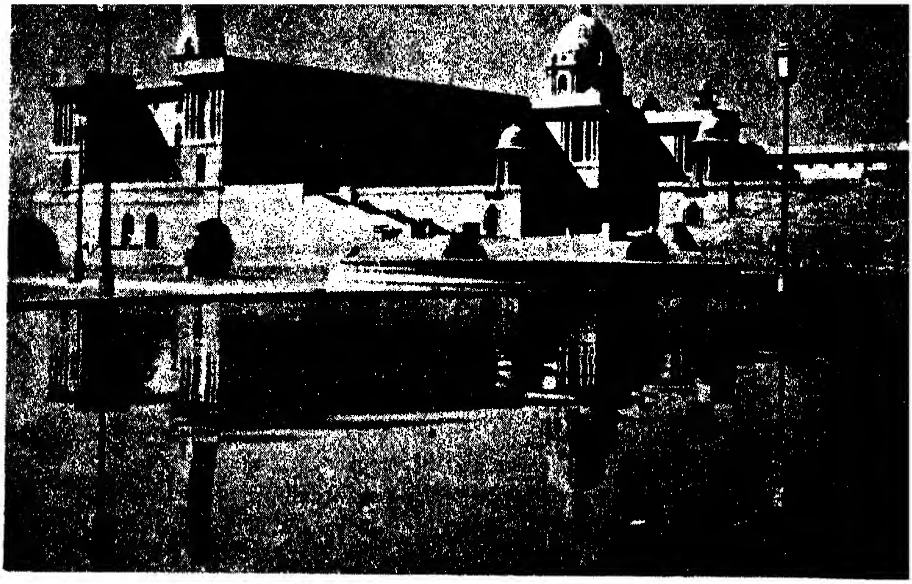
←*Delhi Fort*: *Lahore Gate.*

Health Schemes, such as the improvement of existing hospitals and the establishment of new hospitals, health centres, etc. Water-borne sanitation is to be provided where it does not exist at present and arrangements for an abundant water supply will ensure that Delhi will never in future have to worry about an insufficiency of water during the hot weather season. Expansion of the Power House will ensure an adequate electricity supply.

Roads and streets, both in the rural area and in the city, are to be improved and new roads within the province are to connect existing roads and thus enable farm produce to be brought more conveniently to the city. In conjunction with road developments, the public transport system has been improved and further improvements and extensions are planned and will be given effect to as vehicles and petrol become available.

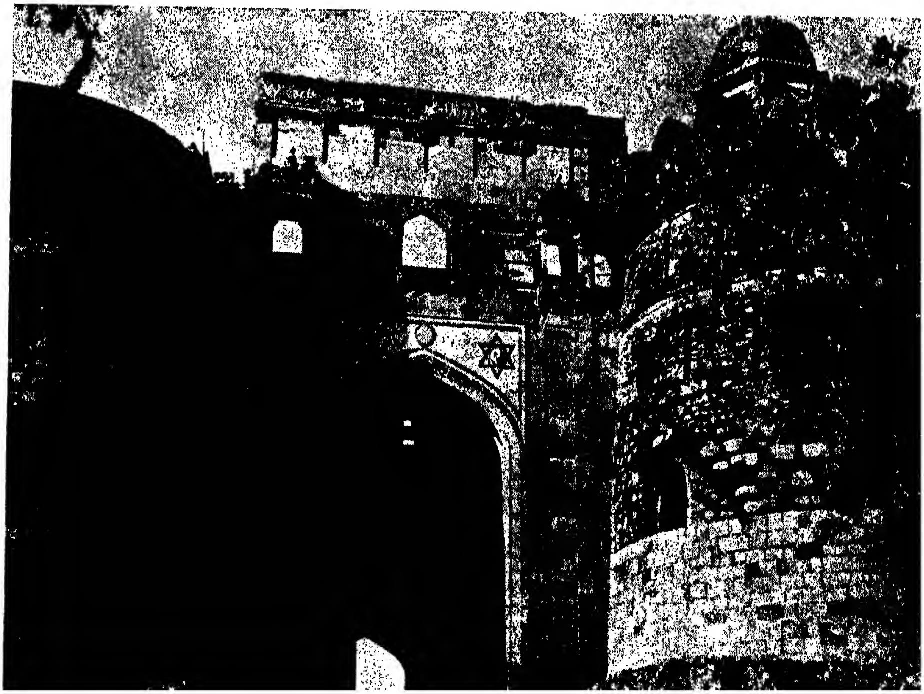
The various developments linked one with the other are intended to bring better living conditions and prosperity to the people of Delhi Province. Thus agricultural developments are aimed at helping the farmers as much as possible who in turn will bring their produce to Delhi City so that the demand for food stuffs from other provinces will not be so great as it has been up to now, or alternatively the standard of living will be improved.

One scheme already in hand provides for rapid transportation of dried sludge and manure to cultivators. Already many thousand tons of this fertilizer have been distributed and the distribution is likely to continue over a long period. The scheme is subsidised so that the cost of a truck load of this valuable manure to each cultivator is very small. The scheme has been developed through the Government of India's 'Grow More Food Scheme' and is coupled quite closely with another agricultural scheme which provides for the subsidised construction of irrigation wells throughout the province. The target for construction of wells is 500 per year for the next five years and already the construction of new wells in Delhi totals about 300, although the scheme was only put into operation about June of this year. The enrichment of the soil through these manures, the improvement of water supply to the fields and other soil conservation schemes which are shortly to be put into operation, *plus* an extension plan for the consolidation of holdings, topped off with a scheme already in operation for the improvement of poultry and egg-production throughout the city and villages in the province, will ensure that better produce, and more of it, will in future be raised in the provincial rural areas for the benefit of all within the province.



Government has allotted Rs $6\frac{1}{2}$ crores for a 5- year development plan of Delhi

PURANA QUILA.— Post-war Development will not affect Delhi's ancient monuments and landmarks



Another scheme for agricultural improvement which is closely linked with urban development is the "Green Belt" scheme. This scheme, now being worked out, will ensure that Delhi urban area will not expand beyond reasonable limits but will extend only to an area limited by a Green Belt around the city at, say, 6 to 8 miles' distance from the centre of Delhi. The Green Belt will be entirely devoted to agricultural purposes, and should Delhi find any necessity for expansion beyond the limit of the inner edge of the Green Belt, then satellite towns are to be provided beyond the Green Belt. It is proposed that cattle now retained in the city should be accommodated in the Green Belt area and a well-planned dairy development scheme for the provision of a better milk supply for Delhi is being prepared by an officer specially appointed for this purpose.

Educational expansion has not been forgotten and plans for considerable improvement in this direction have been made and will be put into operation almost immediately, starting with the opening of Teachers' Training Colleges to ensure that when the new schools are ready, there will be sufficient teachers available to staff them adequately.

It will be realised from the foregoing that Delhi's scheme for post-war development are intended primarily to improve the health of the people, to offer the public better educational facilities to bring a balanced co-operation between the rural and urban areas and in every way to ensure that conditions of life are improved throughout the province. There have been many suggestions that Delhi should be made a model province in every respect, but to bring this into effect would demand financial aid far beyond the amount that has been allotted to Delhi Province for the post-war developments. Some of the features of the developments will be models of improvements for the rest of India, but with only limited finances at the disposal of the Delhi Administration it will not be possible to make Delhi a complete "model province". The plans have all been prepared by specially qualified experts so that whatever is done will be the very best that brains and the money available can produce.

THE CLIMATE OF DELHI

By

Dr. A K. ROY

Only during the three monsoon months, July, August and September, does oceanic air penetrate the country up to the region of Delhi. In its broad features, the climate of Delhi (Latitude 28° 35′N, Longitude 77° 12′ E) is mainly influenced by its inland position and the prevalence of air of the continental type. Both the heat in summer and the cold in winter are extreme and rainfall is comparatively slight during the non-monsoon months. The desert areas of Rajputana to the west and south-west, and the Gangetic plains of the U.P. to the east, across which the monsoon air moves and frequently reaches the Delhi area, have their respective shares in influencing the climate of Delhi and neighbourhood. Extreme dryness with intensely hot summer and cold winter are the characteristics which are associated with a sweep of air from a westerly or north-westerly direction, while the influx of air from the east or south-east usually causes increased humidity, cloudiness and precipitation.

In order to bring out the essential features of the Delhi climate, in the account that follows, the meteorological data of Jodhpur (Latitude 26° 16′ N, Longitude 73° 01′ E) in Rajputana and those of Lucknow (Latitude 26° 52′ N, Longitude 80° 56′E) in the U.P. have been included for purposes of comparison.

Temperature

Table I gives the temperatures during the different months and the year as a whole in respect of the three stations, Delhi, Jodhpur and Lucknow, and in Fig.I is represented graphically the variation during the year, of monthly mean temperatures and also of the monthly extreme temperatures at Delhi.

TABLE I

Mean monthly and annual data relating to temperatures at Delhi, Jodhpur and Lucknow (in °F)

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean temperature	Delhi	57	62	71	82	92	93	88	86	85	78	67	59	77
	Jodhpur	63	67	76	85	92	93	89	84	85	81	72	65	79
	Lucknow	61	65	76	86	92	01	86	85	84	79	60	62	78
Mean maximum temperature	Delhi	71	75	85	97	105	102	95	93	93	93	83	74	89
	Jodhpur	76	81	91	99	105	104	97	92	94	95	88	79	92
	Lucknow	74	79	91	101	105	100	92	91	92	91	84	76	90

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean minimum temperature	Delhi	43	49	57	68	79	83	81	78	75	64	52	45	65
	Jodhpur	49	53	61	71	79	82	80	77	75	65	56	51	67
	Lucknow	47	51	61	71	78	82	79	79	77	67	54	47	66
Range Maxi-Min	Delhi	27	25	28	29	26	20	14	15	18	28	31	29	24
	Jodhpur	28	28	29	29	26	21	16	15	19	30	32	29	25
	Lucknow	27	27	30	31	27	19	13	12	15	25	30	29	24
Highest Maximum	Delhi	85	92	105	114	117	118	113	104	105	103	95	84	118
	Jodhpur	91	97	107	111	120	121	114	107	109	108	99	90	121
	Lucknow	85	95	106	114	117	119	114	102	103	104	94	92	119
Lowest Minimum	New Delhi	31	35	40	53	65	66	71	72	64	49	39	34	31
	Jodhpur	28	31	41	49	63	67	70	70	64	52	43	36	28
	Lucknow	34	35	45	55	64	67	72	72	64	52	36	35	34

Monthly mean temperature is highest in Delhi in the month of June when night temperature is also at its maximum, although the day temperature on the mean is highest in the month of May. The coldest month is January when both the mean maximum and mean minimum temperatures are the lowest, being 71° F. and 43° F. respectively. Mean temperatures at Delhi, taking the year as a whole, are slightly lower than those at Lucknow and Jodhpur, Delhi being distinctly cooler than the other two stations during the winter months, December to March. Diurnal range of temperature is high, ranging between 25° to 31° F. on the mean during the relatively dry months October to May, the highest value occurring in November, while the lowest values of 14° to 15° F. occur during July and August. Lucknow and Jodhpur also show similar features, the point of interest which is common to all the three stations being the abrupt change in the diurnal variation which occurs with the onset of the monsoon and again when the monsoon retreats. As for the extremes, Delhi has a slightly lower maximum than both Jodhpur and Lucknow, the highest ever recorded being 118° F. at Delhi, 119° F. at Lucknow and 121° F. at Jodhpur, the record temperature at all the three stations occurring in the month of June. The lowest day temperature that has so far been recorded at Delhi during the winter months is 53° F. in the month of January, while the lowest minimum temperature at Delhi is 31° F. which also occurred in the same month. This is 31° F. less than the lowest recorded at Lucknow and 3° F. higher than that at Jodhpur.

In table II are given the number of days on which the minimum and maximum temperatures at Delhi lay between certain specified ranges. It is seen that on the mean, night temperature falls to 50° F. or less on 81 days in a year, and lies between 30 and 39° F. on 13 days. Day temperature

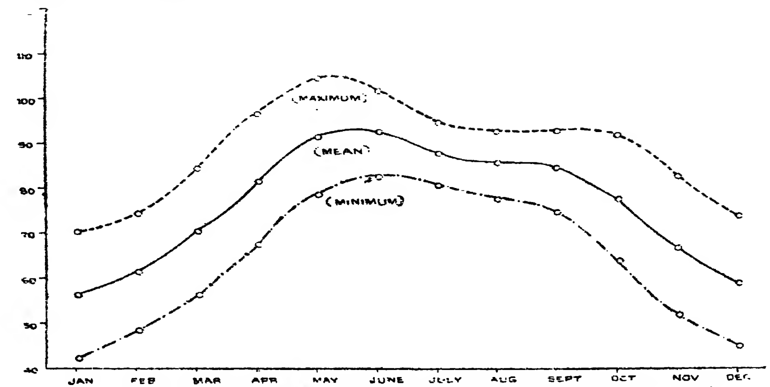


FIG. 1 MEAN MONTHLY TEMPERATURE AND EXTREMES OF TEMPERATURE AT DELHI

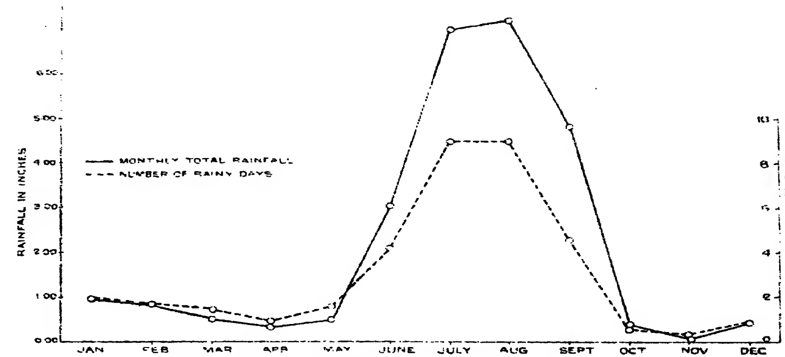
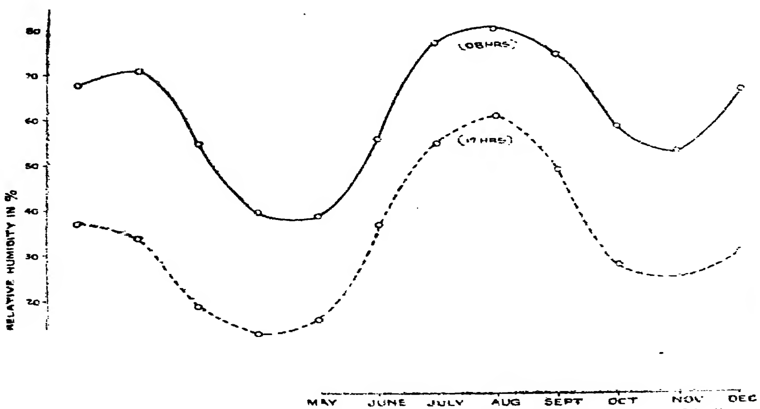


FIG 2 MEAN MONTHLY RAINFALL AND NUMBER OF RAINY DAYS AT DELHI



RELATIVE HUMIDITY AT 0800 AND 1700 HRS AT DELHI

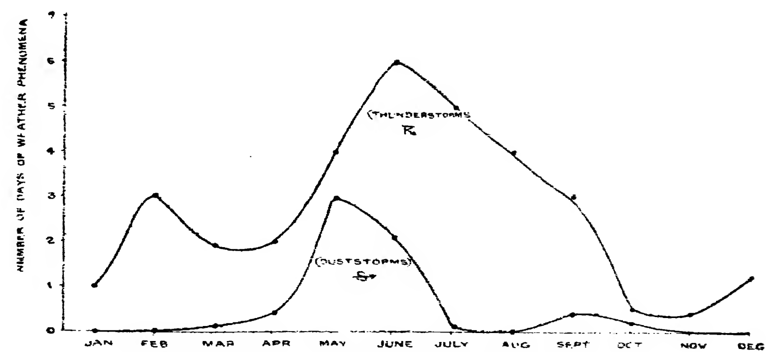


FIG 4 FREQUENCIES OF THUNDERSTORMS AND DUSTSTORMS AT DELHI

reaches 100° F. or higher on 75 days, temperature of 110° or more being recorded on only 10 days in a year.

TABLE II

Number of days in a year on which the minimum and maximum temperatures at Delhi lay between certain specified ranges.

	Minimum temp. (°F.)			Maximum temp. (°F.)		
	50°–40°	39°–30°	<30°	100–109°	110°–119°	>119°
Average No. of days in a year	68	13	—	65	10	—

Rainfall

The annual total rainfall at Delhi is 26".24, which is very nearly the mean of the Jodhpur total of 14".21 and 40".02 at Lucknow. A little more than half the year's rainfall at Delhi occurs in the months of July and August during each of which the monthly normal is slightly over 7". The same feature is noticeable at Lucknow and Jodhpur also where the bulk of the rainfall occurs during the mosoon months, 58% to 62% of the year's total being recorded during the two months, July and August. Two other months during which Delhi receives rainfall of over 1" are June and September, the total of these two months being 7".87. Rainfall during the remaining 8 months, October to May, totals only 4".11, the precipitation during these months being usually slight, except very occasionally, when a heavy shower accompanied by thunder-storm may reach an appreciable total.

In Table III are given the monthly and annual totals of rainfall at Delhi, Jodhpur and Lucknow, and also the data relating to number of rainy days, and the heaviest rainfall recorded in 24 hours in each month. Table IV gives the total number of occasions during the 30 years (1891-1920) on which the day's rainfall at Delhi and Jodhpur was between 3" and 5", between 5" and 7" or exceeded 7". In Figure 2 is shown graphically the annual variation of rainfall and number of rainy days at Delhi, days with rainfall of 0".01 or over being considered rainy. Taking this as the criterion, 36 days in a year or about 10% of the days at Delhi are rainy, and of these exactly half the number fall in the two months July and August. November is the driest month, during which only on one occasion in three years rainfall of 0".01 or over occurs in Delhi. Heavy rainfall amounting to 3" or more in 24 hours occurs infrequently, there being only 31 such occasions during the 30 years, 1891-1920. During this period rainfall in a day exceeded 5" on 8 occasions, and was more than 7" in only one instance.

TABLE III

Annual and Monthly rainfall and number of rainy days and heaviest rainfall in 24 hours.

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Monthly rainfall total in inches	Delhi	0·99	0·83	0·51	0·33	0·52	3·03	7·03	7·23	4·84	0·40	0·10	0·43	26·24
	Jodhpur	0·15	0·24	0·11	0·13	0·41	1·42	3·97	4·84	2·40	0·32	0·11	0·11	14·21
	Lucknow	0·76	0·72	0·34	0·25	0·77	4·46	12·00	11·50	7·40	1·28	0·22	0·32	40·02
No. of rainy days	Delhi	2·0	1·7	1·3	0·9	1·6	4·2	9·0	9·0	4·6	0·6	0·3	0·9	36·1
	Jodhpur	0·3	0·6	0·2	0·5	1·1	2·1	5·5	5·9	2·8	0·5	0·2	0·3	20·0
	Lucknow	1·5	1·6	0·9	0·6	1·3	5·5	13·4	13·7	7·9	1·7	0·4	0·7	49·2
Heaviest rainfall in inches in 24 hrs	Delhi	4·60	3·77	2·45	1·61	1·20	6·29	6·68	7·15	6·95	6·00	0·75	2·10	7·15
	Jodhpur	0·82	0·79	0·58	1·05	1·50	6·02	5·85	6·89	7·48	5·59	1·06	0·71	7·48
	Lucknow	3·75	2·12	1·02	5·10	4·07	9·02	6·04	7·00	9·85	3·71	1·70	1·99	9·85

TABLE IV

Total number of occasions during the 30 years (1891 to 1920) on which day's rainfall was between certain specified ranges.

		3″–5″	5″–7″	>7″
No. of occasions	Delhi	23	7	1
	Jodhpur	11	4	2

Relative Humidity

Table V gives the monthly and annual means of 8 and 17 hours relative humidity at Delhi, Jodhpur and Lucknow. At Delhi relative humidity is maximum in the month of August and is so also at Jodhpur and Lucknow. In this month Delhi, Jodhpur, and Lucknow record 80, 82 and 86 per cent. respectively in the morning and 61, 50 and 77 per cent. respectively in the afternoon. The morning relative humidity at Delhi attains a minimum value of 39 per cent. in the month of May, while the afternoon minimum of 13 per cent. is reached in April. At Jodhpur and Lucknow both morning as well as afternoon relative humidity are lowest in April, Jodhpur and Lucknow values being 35 and 39 per cent. respectively in the morning and 11 and 20 per cent. respectively in the afternoon. Taking the year as a whole, Delhi is slightly more humid than Jodhpur and less humid than Lucknow both in the morning as well as in the afternoon. The variation during the day of the relative humidity at Delhi is 30 to 35 per cent. in the winter months and about 20 per cent. in the monsoon

months. In Fig. 3 is shown graphically the annual variation of monthly mean relative humidity at Delhi at 0800 and 1700 hrs.

TABLE V

Relative humidity normals (in percentage) at 8 and 17 hrs.

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Delhi	08 hrs.	68	71	55	40	39	56	77	80	74	58	53	67	61
,,	17 hrs.	38	35	18	13	16	37	55	61	44	28	25	31	34
Jodhpur	08 hrs.	50	50	39	35	45	63	73	82	76	54	45	53	55
,,	17 hrs.	22	21	17	11	17	35	47	50	39	16	18	22	26
Lucknow	08 hrs	81	71	51	39	46	64	82	86	82	72	73	80	69
,,	17 hrs.	47	41	24	20	31	54	75	77	70	57	52	54	50

Although the highest temperature is reached at Delhi in May or early June, the heat is most trying during late June or early July, when high temperature coupled with high humidity makes the climatic condition most oppressive. In such conditions, it is the wet bulb temperature that determines more correctly the climatic condition at a station from the point of view of human comfort. In Table VI are given the percentage number of occasions when the wet bulb maximum temperature of Delhi lay between certain defined limits during the summer months May to September. It will be seen that wet bulb temperature exceeding 80 F. occurs on 90 per cent occasions in July, and on 12 per cent. of these the value lies between 86° F. and 90° F. The precentage of occasions on which the wet bulb value exceed 80 per cent. in the month of August is 69.

TABLE VI

Percentage number of occasions when wet bulb maximum temperature lay between certain defined limits at Delhi during May to September.

	May	June	July	August	September
61°—65°F	—	—	—	—	—
66°—70°F	32	—	—	—	1
71°—75°F	48	8	—	—	25
76°—78°F	18	12	3	5	26
79°—80°F	2	27	7	26	20
81°—85°F	—	53	78	67	28
86°—90°F	—	—	12	2	—
91°—95°F	—	—	—	—	—

Cloudiness

Data relating to clouds are given in Table VII. Average cloudiness of Delhi, taking all kinds, low, medium or high into account, is less than four-tenths except during July and August, when the average amount is of the order of seven-tenths. Considering only the low clouds, the average amount even during these two monsoon months is less than four-tenths. On a large

number of days during the winter months and also during early summer, the sky is cloudless, with brilliant sunshine. On a few mornings during winter, fog, which is dense at times, collects in low lying places and obscures the sky for a number of hours.

TABLE VII

Mean cloud amount in tenths of sky covered

		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Delhi All Clouds	M	3·2	3·1	2·3	1·9	1·7	3·5	6·3	6·1	3·2	0·9	1·0	2·2
	A	3·4	4·5	3·0	2·6	1·7	3·8	6·3	6·5	3·4	0·7	1·0	2·7
Jodhpur All Clouds	M	3·0	2·8	2·5	2·1	1·2	3·5	7·1	7·5	·0	1·3	1·3	2·4
	A	3·7	3·7	3·2	2·6	1·7	3·5	6·3	6·2	4·1	1·2	1·5	2·6
Delhi Low Clouds	M	1·3	2·0	0·7	0·5	0·2	2·2	3·5	2·3	1·5	0·3	0·3	1·0
	A	1·3	1·8	0·6	1·5	1·5	2·7	3·9	3·4	2·4	0·4	0·2	0·8
Jodhpur Low Clouds	M	0·6	1·0	0·3	0·7	0·4	0·9	6·0	5·2	2·6	0·1	0·3	0·6
	A	0·9	1·4	0·7	1·7	0·9	2·8	4·3	4·2	3·9	1·0	0·4	0·7

Number of days.

Delhi Frequency of low clouds (7-10/10)	M	2	3	1	0	0	4	6	5	1	0	0	2
	A	2	3	0	1	1	1	6	4	2	0	0	1
Jodhpur ,,	M	1	3	1	2	1	6	15	14	6	0	1	1
	A	2	2	3	3	1	4	7	8	5	0	0	1

Surface Wind

Table VIII gives the distribution of surface winds from different directions at 0800 hours at Delhi in different months and also the average daily speed in miles per hour. The prevailing direction of wind during September to May is W or NW. During the other months, while the percentage of winds with westerly component is quite large, easterly components predominate, particularly during the periods of active monsoon. On the average, wind is rather light during the months October to February, but strengthens with the advent of the summer. Steep pressure gradient often gives rise to moderate to strong and gusty winds causing much dustiness, especially during afternoons, in the months April to June.

TABLE VIII

Surface wind direction percentage at 08 hrs. at New Delhi.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec.
N	5	6	6	6	6	3	3	2	3	3	3	2
NE	2	4	5	4	5	4	4	6	7	4	3	1
E	4	4	4	4	9	12	19	13	9	5	4	2
SE	7	8	9	8	19	28	26	21	15	7	4	5
S	2	3	3	3	3	4	4	3	3	2	1	1
SW	5	3	5	7	7	4	5	5	3	5	4	3
W	38	32	28	35	25	21	20	25	33	37	41	46
NW	16	22	26	21	16	15	9	12	17	14	15	20
Calm	23	18	13	12	9	9	10	13	10	22	25	21

Average daily speed in m.p.h. at Delhi.

2·2	2·6	3·0	3·1	3·5	3·9	3·5	3·1	2·8	1·8	1·6	1·9

Thunderstorms, Squalls, Duststorms, etc.

Thunderstorm is an important climatic feature of Delhi. In winter, it usually occurs in association with the cold fronts of western depressions and in summer due to large scale convection caused by various factors. At Delhi thunderstorms may occur in any month of the year, the months most favourable for their occurrence being May to August. Some of the thunderstorms are associated with violent squalls, heavy rain and hail.

Duststorms or dust-raising winds are fairly frequent at Delhi during the months of May and June. Visibility is often reduced to a very poor range during the passage of a dust-storm. Fog occurs at Delhi on one or two days in a month during December to February, usually in association with the passage of western disturbances.

TABLE IX

Frequencies of weather phenomena at Delhi (Number of days)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Thunder	1·0	3	1·9	2	4	6	5	4	3	0·5	0·4	1·2
Hail	0·2	0·2	0·1	0·2	0·2	0	0	0	0	0	0	0
Dust storm	0	0	0·1	0·4	3·0	2·1	0·1	0	0·4	0·2	0	0
Squalls	0	0	0	0	0·3	0·2	0	0	0·1	0	0	0
Fog	1·6	0·6	0	0	0	0	0	0	0	0	0·1	0·5

Table IX gives the frequencies of thunderstorms, hail, dust-storms, squalls and fog. Number of days on which thunderstorms and dust-storms occur at Delhi in different months are shown graphically in figure 4.

DELHI INDUSTRIES

by

Mr. RAJ NARAIN

It is a matter of common knowledge that in ancient India when the means of communication were extremely slow, and transport of goods from one place to another was attended with hazardous risks, artists and master craftsmen flocked to the capital towns where they were assured of rich rewards and encouragement by the ruling chiefs and local nobility. Delhi, in its long career as the capital of far flung Hindu Empires and Muslim Kingdoms of bygone days, attracted the best skilled workers in the cultural arts, samples of whose superb workmanship may still be seen in the exhibits preserved in Indian and foreign museums and in the monumental architectural remains of old Delhi covering an area of over 50 square miles. Of the old industries which spread the fame of Delhi beyond the borders of this country, a few are still flourishing. Among them are the ivory carving and miniature painting; gold and silver embroidery; lametta and *kalabatoon*; gold and silver jewellery, and household utensils. Industries concerned with the production of gold tissue fabrics, wood and stone carving, arms and armour and illuminated manuscripts have died away.

The modern city of Delhi and New Delhi with a population exceeding 10,00,000 inhabitants is not only the largest commercial centre in Northern India, but also an important industrial centre. The location of the Department of Supply in Delhi has been responsible, in a large measure, in more than doubling the number of registered factories alone during the six years of War, from 111 in 1939 to 227 in 1945 with a corresponding increase in the number of operatives employed, from 17,400 to 36,870, besides bringing into existence a very large number of small establishments for the production of military requirements and consumer goods. A detailed survey of the Delhi Industries has just been completed of which a brief summary is given below to enable the reader to get a bird's eye view of the factory and cottage industries of this city.

Textiles

The textile industry comprising 4 cotton mills, 7 small scale hand and power loom weaving factories, 21 hosiery factories, 20 newar tape and webbing factories, 19 lace mills, 90 thread balling factories and over 55 lametta factories occupies the forefront of manufacturing activity of the province.

Cotton Mills. The premier cotton mill of Delhi dates back to the year 1889, and ranks among the most progressive ones in the country. The aggregate capital investment of the 4 cotton mills in Delhi amounts to Rs. 1,95,00,000 and provide employment to over 13,000 workers. The total number of spindles and looms installed in them is 1,10,780 and 3,326 respectively and their combined annual output amounts to 46,760,000 lbs. of yarn and 94,000,000 yards of piece goods besides 3,21,000 dozen towels. Nearly 95 per cent. of the yarn produced is of counts up to and below 30°. Of the piecegoods production, the fine qualities are; cambrics, *mulmul, Saries* with all-over designs and floral borders, *dhotis*, shirting and coating and ladies dress materials ; the medium qualities, *khadi*, long cloth, sheeting cloth, tapestry and furnishing fabrics, *dosuti* ; and the heavier qualities, tent cloth, *Khes*, *soojnis*, drill, towels, dusters and other grey goods.

Hand & power loom weaving . The small scale textile factories are equipped with hand and power looms, the largest number of the latter in any one factory being 16 and the smallest 3. Those among them which came into existence before the war, started with the production of silk, tussor and staple fibre shirting, suiting and *saries*, woollen suiting and shirting and cotton towels which were well received in the local, Punjab, N. W. F. Province and Sind markets. They had, however, to give up the silk and woollen lines due to the non-availability of those yarns during the later years of the war. The main varieties now turned out by them include cotton tapestry cloth, *khaddar*, twill, *doria*, *dosuti*, and coloured and striped shirting and coating with an aggregate monthly production of about 85,000 yards.

Hosiery. The hosiery industry received considerable impetus during the war years resulting in the establishment of 10 new factories out of the existing total of 21. The capital investment in the industry is estimated at Rs. 10,78,000 and it provides employment to 1,200 workers. While the hosiery industry at Ludhiana in the neighbouring province of the Punjab was mainly concerned with the production of woollen goods, the Delhi factories wisely specialised in cotton undervests and socks turned out on power driven machinery thereby avoiding competition with that centre and creating a stable market for themselves.

Niwar tape & webbing. The *niwar* tape and webbing industry owed its existence directly to the war demand for webbing, tubular parachute rigging lines, tapes, chevrons and *niwar* required for tentage, etc. During the war years the industry provided employment to nearly 450 operatives and attained a monthly production of 30,00,000 yards of those

goods. On the termination of the Supply Department orders some of the factories closed down, while the others took up the weaving of *niwar*, lamp wicks and cordage for the civilian market. There are nearly 200 varieties of cotton, silk, rayon and woollen tape in demand and the more enterprising among the existing factory owners are planning to meet the demand as soon as the position regarding supplies of yarn improves.

Lace and Trimmings. Over a hundred different varieties of cotton, silk and *zari* (gold and silver thread) lace, *sari* borders and trimmings are produced by the lace mills of Delhi, which provide employment to nearly 500 men. The short supplies of the main raw material of the industry *viz.* rayon yarn and the phenomenal increase in its price in recent years has imparted a serious set-back to the industry. Apart from lace and trimmings, one modern concern specialises in woven labels and name tags for the hosiery trade, tailors and drapers; name tapes for household linen ; badges and woven titles for the army, clubs etc.; and made-up small ware such as trouser braces, belts, bandings and bandages.

Thread Balling. The thread balling and embroidery and crochet yarn industry with its annual production of over Rs. 70 lacs, ranks among one of the major industries of Delhi. Of the 4,500 operatives estimated to be employed in it, 85 per cent. are women, 10 per cent. men and the rest children. The total number of balling machines is nearly 3,000 and would require 1,500 bales of yarn per month if worked to capacity; but they can barely obtain one-third of their requirements due to rationed supplies. The coloured embroidery and crochet yarns in bales and skins have secured a firm foothold in the market in the absence of foreign competition during the war years.

Lametta. The gold and silver wire drawing industry has been carried on in India from time immemorial and numerous references to it occur in old Hindu literature and histories of the Muslim period. "Mohammad Tughlak in the 14th century kept at Delhi 500 weavers to make gold brocades worn by his wives or distributed as royal presents with a generous hand". In Akbar's time Delhi, Agra and Lucknow were the chief centres of production. Sir George Watt in his official catalogue of the Delhi Exhibition of 1902-03 notes : "By way of concluding these jottings regarding gold and silver wire drawing, it may be said that it has been estimated Delhi alone produces over 3,00,000 miles of these wires per annum". The Delhi manufacturers, however, began to change over from the production of real silver (*rupehra*--white) and silver coated with gold

(*Sunehra*—golden) lametta to imitation lametta with copper wire as the basic material in 1914. There was a rapid development of the industry in the following years consequent upon the introduction of power driven machinery till at the present time Delhi has become the largest centre in India for the production of imitation lametta, laces, braids, *pemak, gota* and *kalabatoon* which are exported to all parts of the country. The industry provides employment to nearly 1,000 men.

Metal Industries

Next in importance only to the textile industries, the metal working trades occupy the second place among the manufacturing industries of Delhi. In point of age also, some of the leading concerns in the line trace their history to over 150 years back as actual manufacturers of iron hardware. The inception of iron foundries and large engineering works for heavy casting and machining, however, dates from the seventies of the last century. Before that period the main products of the industry were agricultural implements, axles of bullock carts, iron household utensils, structural materials, tradesmen's tools, files, etc., for which Delhi has for centuries past been a large distributing centre.

The first stage in the history of the modern metal working trade of Delhi is marked by the etablishment of three large foundries during the year 1871—1874 for the production of sugarcane crushers and cast pillars and *jali* blocks for ventilators and verandah railings. More engineering workshops continued to be set up in the following years, particularly for the manufacture of mill machinery parts. The second stage in the development of the metal trade, began in 1911 when the shifting of the capital of India from Calcutta to Delhi, entailing the enormous building programme of the New Delhi area with modern sewage system, laid the foundation of a new line of production in sanitary fittings, underground electricity cable fittings, electric poles, etc. The third stage may be said to have been reached about 1920 when greater engineering skill and more adavnced technical knowledge began to be applied to castings of all sorts and the local production of oil and steam engines and mill machinery parts. The peak of progress was reached during the war years when numerous workshops sprang up in the city for the production of a large variety of goods ranging from hair pins to certain capital goods of which local production had not attempted so far.

Iron Foundries and large Engineering Works. These establishments which are 14 in number were all established before the war with the exception of only one. Their aggregate capital amounts to nearly Rs. 21

lacs and they provide employment to over 1200 men. Their major item of production is sugar cane crushers of which the annual outturn is estimated at 3,700 complete crushers and nearly 7,500 sets of spare rollers for the seasonal replacement of worn out ones or for the erection of new crushers on wooden stands by village carpenters. The other argicultural implements produced are chaff cutters, Persian wheels and power driven water pumps for well irrigation. Other manufactures are :

Sanitary fittings and pipes, manhole covers, fire hydrants, conservancy carts, dust bins ;

Structural fittings, fencings, collapsible doors, verandah railings, lamp posts, lamp brackets, garden benches, spiral staircases;

Machine tools and parts thereof like lathes, band saw machines, shearing machines, hand presses, corn grinding mills; shaftings, collars, couplings, pulleys, parts of sugar, textile, flour and ice mills machinery and of electricity generating stations. Small equipment such as vices, plumber blocks, hand blowers, nuts and bolts;

Miscellaneous items such as Railway fittings, road roller wheels, lantern bases, vaporisers, tonga and cart axles, cylinders of iron and brass for deep wells, filters, strainers, half way valves, juice machines, weights, dumb-bells, and gratings;

Requirements of the Defence Services such as, bomb rack cradles, parachute containers, terminal boxes, stirrup pumps, foot air pumps, set containers, petrol tanks, semi-rotary pumps for high octane spirit, meter boxes and surface boxes.

Sanitary Appliances. Nine concerns with an aggregate capital of over Rs. 8 lacs and employing nearly 200 men specialise in the production of municipal requirements such as night soil carts, sullage and refuse carts, storage tanks, dust bins and receptacles, drainage pipes up to 4", household sanitary equipment such as flush latrines, flush cisterns, septic tanks, chemical latrines, laboratory pipes, taps, water cocks, brass water and steam fittings, bib cocks, stop cocks, float cocks, wheel valves, water pump plates, petrol pullers, etc. The majority of the concerns are contractors to the Delhi Municipality, Government and Railway Departments.

Public Health Requisites. There are 5 concerns in this line which engage in the production of anti-malaria and anti-insect appliances like hand and shoulder sprays, pedal fungicide sprays, double acting sprays, strirrup pumps, grease and dust guns, steam sterilisers for hospitals and laboratories, ether containers, fire hose couplings, etc.

Engineering, General. Serious attempts were made, particularly during the war years, to bridge the gap created by the shrinkage in the imports of machine tools, by local production. Apart from the machine

tools manufactured by the large engineering works referred to above, some of the progressive factory owners copied imported machines or devised their own factory equipment for such industries as flexible and radio wires, cream cartons, lead and crayon pencils, candles, etc. Among hand tools may be enumerated bench, pipe and machine vices; hammers, chisels and masons', carpenters' balcksmiths' and shoe-makers' tools. There are 21 concerns engaged in these lines with a total capital investment of Rs. 8,85,000 and they find employment for 395 operatives. Another 440 workers are employed in 99 repair workshops which undertake all sorts of repairs of oil and steam engines and factory plants and carry out replacement of worn out parts. Cylinder boring and production of bearings for electric fans and dies for hand presses, bicycle parts, etc., are their other activities.

Sheet Metal Work. Hundreds of small scale establishments providing employment to thousands of workers were set up during the war years for the production of sheet metal goods both for civilian requirements and for the Defence Services. The majority of them utilised sheet cuttings, defectives and waste materials from the larger concerns but their aggregate contribution of manufactured goods was quite considerable. Particulars regarding them are summarised below :

Description of goods produced.	No. of establishments.	No. of persons employed.
Door and window fittings: hasps and staples, hinges, tower bolts, door handles	22	237
Trunks	116	453
Iron safes	4	25
G. I. buckets and tubs	27	120
Angithi makers	40	120
Buttons—tin, aluminium and G. I. for shirts and pants, brass buttons for coats and waist coats, spring buttons for ladies garments, shirt studs and links, motor hood buttons, buttons for purses and leather bags, etc.	116	1,575
Blue tacks and horse shoe nails ...	50	250
Tent rings and shoe eyelets	38	400
Tin cans	29	320
Suit case and trunk fittings	17	265
Tin toys	20	270
Safety pins	8	43
Cycle parts	5	74
Door fittings	25	410
Lamps, lanterns and tonga bells	8	60
	525	4,622

Miscellaneous Metal Industries. There are 2 modern factories in Delhi for the production of snap locks, 1 for gear operated blower-fans and 3 for blow-lamps and welding stoves, one of which has also produced gas lanterns and stoves on an experimental basis pending import of precision tools required for their manufacture on a commercial scale. One up-to-date concern has been set up for the production of wood screws and rivets and the concern also produces Dietz type hurricane lantern parts in its factory. A large scale tin printing factory has been in existence in Delhi since 1934. A small beginning has been made in the production of school geometrical instrument boxes and simple scientific instruments and laboratory equipment such as steam and air circulating ovens, calorimeters, rain gauges, assembled instruments from imported parts such as spectrometers, Fortin's barometers and Young's Modulus apparatus. There are 74 large and small establishments for nickel and silver plating.

Automobile Engineering. Delhi is one of the most important centres for distributing imported automobiles and for automobile engineering. The workshops of 11 concerns are registered under the Factories Act while there are nearly 50 other small establishments which undertake engine reconditioning, spray painting, cylinder reboring and repairing work of all types. One establishment specialises in the production of link type motor fan-belts, fibre washers and clutch facings.

Ceramic Industries

The ceramic industry covers 9 potteries, 6 reinforced concrete and cement-ware factories, 4 glass works, 3 chalk, crayon and lead pencil factories and enamelware factories.

Potteries. China clay is available in large quantities in the province. Although the local clay is highly micaceous and not quite white in colour, it is eminently suitable for the production of stoneware goods. The first attempt to exploit the local clay was made over 40 years back in the production of fire-bricks and tiles. The inception of modern potteries for the production of stoneware jars started in 1914 and the industry received large impetus during the war when the number of local factories rose to 9. Their aggregate capital exceeds Rs. 12,00,000 and nearly 400 men are employed in them. The main products of the industry are stoneware acid and pickle jars in various shapes and designs, stoneware pipes, fire-bricks and other refractories, cleats, insulators, china clay plates for electric heaters and stoves, decorative vases and figurines, spitoons, bed pans, latrine and urinal seats and crude

crockery such as teapots, milk and sugar pots, tea cups and saucers, *pialis*, etc.

One of the local potteries also produces fire cement and magnesia compositions.

Cement products. The 6 concerns in this line find employment for nearly 400 workers. Their major products include sanitary-ware such as sinks, baths, urinals, cement mosaic tiles, table tops and garden ornaments. One of them is concerned with the production of reinforced cement concrete pipes for drainage and irrigation purposes, electric poles, septic tanks, dust bins, sanitary cabins, air shelters, etc. The small scale establishments specialise in lattice work cement blocks for ventilators and decorative purposes.

Glassware. The glassware industry is still in its infancy. Of the 4 glass works, one produces only crude glass slips for the glass bangle industry of Ferozabad in the United Provinces and another one only glass bottles and phials. The other two which are fairly large scale enterprises produce lantern globes, tumblers, jars, table plate and fancy goods such as flower vases, in a large variety of designs.

Chalk Crayons and Lead Pencils. The premier concern in the line was established in 1931 and its products include chalk pencils, crayons, water colours, tailors' chalk, black lead and coloured pencils and plaster of Paris. The goods of the factory are of a fairly high quality. Two other concerns were set up during the war years for the production of black lead, copying and checking pencils which were in extremely short supply. The industry has not been able to make a good headway as a satisfactory substitute for the African red cedar wood for pencils has not been discovered in India and Ceylon graphite has been difficult to obtain.

Enamelware. Among the products of the enamelware factories of Delhi may be enumerated utility-ware such as plates, mugs and soap cases; hospital accessories such as surgical trays, bed-pans, urine pots, kidney trays and wash basins, electrical enamelware such as double conical fittings, coolicone reflectors, water tight reflectors and E. I. shades, and miscellaneous goods such as hand brackets, hand inspection lamps and name plates. The 4 enamelware factories find employment for nearly 250 men and their aggregate capital investment amounts to Rs. 5,00,000. The factories are well equipped with machine tools but they have not been able to work to capacity due to short supplies of steel sheet and the various chemicals of the industry.

Electrical Goods

Electric Fans. Of the 5 manufacturers of electric fans in Delhi, 3 produce only ceiling fans, 1 only table fans and 1 both ceiling and table fans. The table fans are both fixed and oscillating types and are made in 12", 14" and 16" sizes while the ceiling fans are made in 36" to 56" sweep. The monthly production of ceiling and table fans amounts to 500 and 400 respectively. The capital investment in the industry is estimated at Rs. 5,12,000 and it provides employment to nearly 350 men.

Radio Receiving Sets and Allied Equipment. There are 3 concerns in Delhi for the production of radio sets, the imported parts used in their construction being mainly valves and volume controls. The parts locally produced by the top ranking concern, which made large supplies of Field receiving sets to the Defence Services, are variable condensers, radio frequency chokes, transformers, high frequency inductances and coils, radio hardware, condensers and amplifiers. The 3 concerns find employment for 75 skilled workers and their aggregate monthly production ranges from 200 to 250 receiving sets.

Battery Separators. These may be made either of wood, ebonite or glass, but the 3 manufacturers of Delhi have so far used only wood for their raw material. The daily production is about 8,000 pieces.

Flexible and Radio Wires. 106 machines were installed in 14 factories for the production of flexible wire of which the first factory was put up in 1943. The smaller concerns were, however, obliged to close down towards the end of the following year due to scarcity of yarn for braiding. Besides flexible wire one concern specialises in insulated radio aerial and hook-up wires.

Electrical Utility Ware. The items produced include room heaters in various designs, smoothing irons, tea kettles, hot plates, frying pans, milk jugs and sealing wax heaters. There are 25 establishments in this industry of which three are medium sized while the rest are small scale ones. The industry is a seasonal one, the busy season being the five winter months. The money value of the annual production is estimated at about Rs. 2,00,000.

Food and Drink Industries

Squashes, Preserved Fruit, Pickles, etc. The most reputed industry of Delhi under this heading is that of fruit juices, preserved fruit, pickles *achars*, etc. for which this city has been well known far and wide for centuries past. Some of the products of their trade form important items of the ancient indigenous systems of medicine like the *murabba* of *amla*

(Myrobalan) and *gulkand* (preserved rose petals) which Delhi exports in large quantities not only to all parts of the country but also to overseas markets. Even in the days of the East India Company, Europeans used to carry Delhi pickles and preserved fruit as presents for their people at Home. The development of the industry on modern lines is, however, of recent origin and owes much of its present importance to the application of scientific methods to old processes of production by some of the leading concerns in the line who have equipped their factories with up-to-date sterilizing, rosing, juice extracting and canning machinery. The equipment of one of the factories, which claims to be among the most modern in the country, includes steam jacketted cooking pans, pressure cookers, boiler, pasturising outfit, hand and mechanical seaming machines, besides other auxiliary apparatus. The restricted import of fruit juices and preserved fruit and pickles, etc. during the war years provided a large impetus to the local industry and the war years witnessed the establishment of 6 new concerns for the production of modern drinks and table delicacies like fruit squashes, crystallised fruit, candied peels, jams, jellies, marmalades, tomato ketchup, chutneys, etc. The total number of modern factories at present is 14 whose aggregate capital amounts to Rs. 7,45,000 and they provide employment to nearly 350 workers. The total value of their annual output is estimated at Rs. 16,00,000 as compared with Rs. 5,90,000 in 1939. Of the total production of the Delhi factories in pre-war days, 15 per cent. was consumed locally, 75 per cent. was exported to other places in India and 10 per cent. was exported overseas to Persia, Egypt, East Africa, Burma and England. The export trade came to a virtual stop in 1941 due to lack of shipping accommodation. The increase in the Indian demand, including supplies made to the Defence Services, however, more than compensated for the stoppage of exports. But the further expansion of the industry was checked by the short supplies of sugar and packing materials and the rise of over 400 per cent. in the prices of fruit.

Flour Milling. The aggregate monthly corn grinding capacity of the 3 old established large flour mills and 3 medium scale ones amounts to 3,19,000 maunds, while the 233 small *atta chakkis* installed in all parts of the province are estimated to produce another 3,00,000 maunds of flour per month. The industry provides employment to nearly 1600 workers.

Ice. Delhi has 5 ice factories with a total daily plant capacity of 255 tons of ice. The total capacity of these concerns amounts to R . 7,78,000 and they provide employment to 140 men. Three of these factories have steam driven plants while the other 2 have electric plants.

Before 1942, the Delhi factories supplied their ice to Alwar and Jaipur States, all principal stations on the B. B. & C. I. and G. I. P. Railways upto Jhansi and Beawar, Ambala and Panipat in the Punjab and Meerut, Dehra Dun and Saharanpur in the United Provinces. With the heavy increase in the population of Delhi during war years the production of the local factories fell short of the demand and eventually in 1944 the sale price of ice was controlled and exports were totally stopped with the exception of supplies to railway restaurants and dining cars.

Vegetable Oil Milling. This industry is carried on in Delhi Province in well organised, power-driven factories as well as cottage establishments with bullock driven *kolhus.* The aggregate number of expellers and *ghanis* installed in the 9 organised factories is 4 and 169 respectively and their monthly output averages 10,000 maunds of oil. The capital investment of these mills is estimated at Rs. 7,35,000 and they provide employment to nearly 200 men. The Delhi oil mills produce mostly *kachi ghani sarson* oil which retains its pungent odour and is largely in demand in Bengal and Bihar Provinces with very little local consumption. The number of bullock driven *kolhus* in the province is estimated at 300 which attain a monthly production of 1,700 maunds of oil. Nearly half the produce of bullock driven *kolhus* consists of *til* oil, which, after purification, is used for hair and toilet oils as well as for edible purposes.

Hydrogenated Oils, Artificial Butter and Butter Colour. There is one factory for each of the three products under this head. The hydrogenated oils factory is a large scale one and has been in existence since 1939. The factory for the production of artificial butter which was set up in 1944 could not start commercial production due to short supplies of its basic material *viz.* hydrogenated oils and is lying closed at present. The production of butter colour is carried on in a small scale and is of little commercial importance.

Chemicals and Chemical Products

Heavy Chemicals and Pharmaceutics. These industries find employment for 530 men in 9 well organised factories. The more important chemicals produced by them include sulphuric, nitric and hydrochloric acids, ferric and potash alums, sulphonated oils, refined sulphur, magnesium sulphate, ferric sulphate, sodium sulphate, potassium sulphate, superphosphate and zinc chloride, and pharmaceuticals such as tinctures, ointments, decoctions, extract infusions and liquors, of B. P. and French Codex standards. The leading concerns are planning further development

by the addition of modern plant and equipment for obtaining increased production of sulphuric acid by contact process plant and for the manufacture of alumina sulphate, fertilisers, etc.

Soaps. There is only one large soap factory in Delhi equipped for production of soaps of all kinds including soft soap and curd soap; 8 medium sized establishments employing cold and semi-boiled processes and nearly 250 small soap works. They produce a large variety of laundry, toilet and shaving and medicated soaps. A plant for the production of pure full-boiled laundry soap from oil waste was put up in 1942 by the local hydrogenated oil factory; and many local concerns manufacture very cheap grade laundry soap by substituting *sajji* (alkaline earth) and calcium oxide for sodium hydroxide.

Paints and Varnishes. All the 5 existing paint and varnish works in Delhi were set up during the years 1942 and 1943. Their major products are paints with zinc oxide base, cellulose paints, anti-corrosive paints, oil and spirit varnishes, enamel varnishes, colours for cement flooring, wood preservatives, steel coats, adhesives and putty. The annual production of Delhi paint and varnish works is estimated at Rs. 10,00,000. The industry provides employment to over 100 men.

One of the chemical works started the production of powdered and oil-bound distempers towards the close of 1943 which compare favourably with imported varieties.

Match Manufacture. A match works was set up in Delhi-Shahdara in 1931 with a plant capacity of 5 cases per day. The plant was shifted to Sarai Rohilla in 1935 but worked intermitantly and finally suspended operations in 1941. It resumed operations in May 1944 with an increased capacity of 12 cases per day.

Miscellaneous Chemical Indsutries—Candles. 18 establishments were set up in 1943 for candle manufacture on cottage basis with simple machines which were designed locally. Owing, however, to short supplies of paraffin wax only 4 remained in the field by the beginning of 1945. The value of annual production is estimated at Rs. 3,00,000.

Disinfectants: 53 small scale establishments carry on the production of liquid disinfectants with phenol base, atomiser liquid for sick rooms, Paris salts, carbolic powder, blue sanitary powder and vermin exterminants. The concerns are handicapped by lack of adequate capital and essential equipment and the requisite scientific knowledge.

Inks. Delhi is well known for its black Indian ink used by school children for writing on wooden *takhtis*,* and by indigenous commercial

establishments for writing up their account *bahis*, and enjoys a large export market in this trade.

At the outbreak of the war no less than 30 different varieties of powder, fluid and fountain pen inks were placed in the market by local manufacturers. The shrinkage in the supplies of imported colours and other raw materials dealt a severe blow to the industry as a result of which there was a deterioration in the quality of the local products and nearly half of the concerns closed down. The manufacture of printing inks was started by two concerns but they did not meet with much success.

Sodium Silicate. There are 2 factories in Delhi for the production of sodium silicate with an aggregate daily production of 10 tons.

Miscellaneous Factory Industries

Rubber Goods Industry. There are 3 modern factories for the production of moulded rubber goods in Delhi and one for re-treading of motor tyres which find employment for more than 200 men. The moulded rubber goods factories were all established during the war years and the latter in 1935. The range of moulded goods produced cover bottle stoppers; rings and washers; shoe heels; rings for sewing machines and bicycle handle grips, brake shoes and pedal bars; gunners' ear plugs; rubber caps for crutches; and cab tyres. One of these factories is equipped with an efficient plant for reclaiming rubber from old automobile and cab tyres and tubes which formed the main raw material of the industry when supplies of latex were restricted. The major product of one of these concerns is rubber sheets. All the three concerns executed large orders for the Supply Department during the war years.

Water Proof Products. An up-to-date factory was put up in 1943 to meet the requirements of the Defence Services for water-proof cloth and wax paper. There is a very large civilian demand for butter paper; but in the opinion of the concern, the industry can make further progress only if regular supplies of better quality paper than is available at present, are assured.

Celluloid Goods. An enterprising dealer in watches and clocks successfully devised the necessary celluloid sheet cutting, shaping, rolling and polishing machines for the production of unbreakable watch glasses and transparent watch cases which have been well received in the market. The concern also prints clock and time-piece dials on thick glazed paper.

Paper Products. A local concern broke new ground by setting up a factory in 1944 for the manufacture of cream and ice cream cartons and

hoods and discs for milk bottles of which large supplies were made to Government purchasing departments. Due, however, to the shortage of the requisite quality paper, the concern was obliged to suspend production. Paper products provides inexpensive, clean and hygienic containers for articles of food and medicinal preparations and include in their range paper plates and picnic crockery; straws for cold drinks; pastry and sweet hoods; and ointment and pill boxes.

Playing Cards. The first playing cards manufacturing factory was set up in 1942 and gradually the number of manufacturers has now risen to 11. Due, however, to the short supply of paper board, the total output of the industry is restricted to about 1000 gross packs per month, but the present turn-over can be more than tripled with the existing plant if sufficient quantities of raw materials become available. The main competitors of Delhi manufacturers are Bombay concerns who employ the offset litho printing process as against the comparatively inefficient block printing done by Delhi producers. Besides, the greater proportion of playing cards printed in Delhi are unglazed as there are only two varnishing machines in Delhi.

Ivory Carving. Ivory carving along with its secondary branches of miniature painting and ivory inlay work on wood occupies the first place in the art industries of Delhi. The remote antiquity of the industry has been testified to in the Jury Report on Ivory of the Exhibition Committee of 1864 in the following words : "From the earliest times of which we have any record, India has not only had a sufficiency of ivory for its own requirements, but a large surplus for exportation.........From the presence of this valuable material in such abundance and the luxurious tastes of the princes and nobles who successively surrounded themselves with all that skill could produce and wealth command, it is natural that India should produce the most cunning workers in ivory". The chronicler of the Official Catalogue of the Delhi Exhibition of 1902-03 considers the establishment of the industry in Delhi as contemporaneous with the Delhi Empire "The best collective display of ivory at the Exhibition" was furnished by the Delhi manufacturers whose products were marked for their "marvellous perfection" and "triumphs of skill".

At present 90 per cent. of the ivory used for high class carving in Delhi is of African origin, 5 per cent. is Burmese and 5 per cent. Indian. The African ivory which is obtained from the tusks of wild elephants is considered superior to that of tame or domesticated elephants which is brittle and develops cracks. The range of products varies from low priced

bangles, brooches, necklaces, shirt buttons and studs to elaborately carved and costly caskets, richly caparisoned elephants, chariots, country boats carved out of a whole tusk wtih double rows of rowers; perforated partitions, table lamps and a large selection of other decorative designs. The most ambitious piece of work executed in recent years was a full sized drawing room sofa set in 3 pieces and a door screen which took nearly a year and a half to design and 5 years for 20 of the most skilled carvers to complete. Another example of delicate carving and miniature painting is provided by a chest depicting the complete story of the holy scriptures of the *Ramayana* on the top lid and of the *Mahabharata* on the side panels which took 4 years for execution.

The war years witnessed an unprecedented increase in the demand for ivory carvings, which was partly due to the elimination of China as a competitor and partly to the establishment of the American Army Headquarters and other offices in Delhi. The foreigners preferred presents of ivory for people at home to other artware. The industry affords a large selection of utility-ware to the foreign buyers like cigar and cigarette boxes and holders, tobacco pipes, shoe horns, salt and pepper shakers, paper knives, chess sets, card cases, toilet sets and jewellery boxes.

Gold and Silver Embroidery. While the main distinguishing feature of the gold and silver embroidery of Lucknow, according to an authority on Indian art industries, is its "ostentatious grandeur" and of Burhanpur, its "barbaric simplicity", the work of Delhi embroiderers has been characterised by him for its "dignity of style". Although with the march of time, numerous modern designs based on European patterns have been introduced in recent years to satisfy the caprices of changing fashions, the traditional local designs which remain unsurpassed in the delicacy of their conception still continue to exercise their hold on the buyers. The demand for embroidered goods, likewise, has not registered any contraction in spite of the general inclination in favour of simplicity in men, women and childrens' wear as the dictates of custom require an embroidered piece of garment for ceremonial occasions like marriages. The industry supports nearly 1,200 workers of whom about 450 men and 150 women work with real *silma* and the rest with imitation tinsel. Ready made real *silma* embroidered garments are not stocked for sale like the well known gold tissue fabrics of *Kimkhab* and *Zarbaft* of Benares, but the embroidery work is executed only to order with particular reference to the quantity of *silma* to be used up in the design which is charged for by weight. Delhi has, however, a large export trade in cheap quality ready made childrens' caps embroidered with imitation tinsel.

Imitation Jewellery. While Delhi has for centuries past enjoyed the reputation as the premier centre for the production of gold and silver ornaments of a high standard of artistic merit combined with superb workmanship, it is no less well known as an important producer of mock jewellery from the baser metals, of copper, brass, bronze and zinc. The oldest concern in the line traces its establishment to the year 1805. The heavy increase in the prices of the precious metals coupled with the cessation of competition of cheap imitation jewellery imported from Japan and Czechoslovakia provided considerable impetus to the industry during the war years when the number of establishments rose to 51 with an aggregate number of 320 men employed in them. Their range of production includes bangles, ear-rings and ear-drops, finger rings, hair clips, necklaces, brooches, fancy buttons and various other ornaments in tasteful designs in plain styles with high polish; enamelled in multi-coloured patterns and studded with imitation stones. The annual production of the industry is estimated at over Rs. 5 lacs and large quantities are exported to the Rajputana States, the Punjab, N.W.F. Provinces and United Provinces.

Copper and Brass Utensils. Besides being a large distributing centre for copper and brass utensils imported principally from the Punjab and the United Provinces, Delhi is itself a large producer thereof with an annual output of the estimated value of over Rs. 2 crores. Of the 5,100 cottage workers engaged in this industry, 1800 are brass smiths, 800 copper smiths and 2,500 Moradabad type moulded goods makers. The varieties and shapes produced are a legion and include all types of cooking and serving utensils and other utility-ware like *surahis* (water vessels) *pandans* (betel leaf container with numerous compartments for betel nuts, chewing tobacco *katha*, lime, cardamoms, etc.), soap dishes, posts for beds, basin and ewer. buckets, *kohl* and scent stands, hubble-bubble, baby's milk feeder, cruet stands, modern table-ware in foreign designs, flower pots, etc. The copper and brass smiths of Delhi have, however, confined themselves to the production of household utility-ware to the practical exclusion of artistic decorative ware for which Jaipur, Bangalore, Lucknow, Moradabad and Kashmir are so well known. The only decoration done in Delhi is by die-press stamping of raised designs and some hand chasing. The shapes and finish are not only equalled but excelled in most of the neighbouring utensil making centres of the Punjab and the United Provinces. While there is a general preference for heavy quality hand beaten ware, machine finished goods of lighter weight and high polish and electroplated modern tableware are also finding an increasing market. A few concerns specialise in the production of automatic cookers of patented designs and tiffin carriers, water boilers, etc.

Wire Netting. A notable instance of the adaptability and resourcefulness of Delhi industrialists is provided by the local production of wire netting by converting the ordinary type of fly shuttle loom for the production of sieving gauze and fencing and mosquito netting. In pre-war years fine quality copper wire gauze was mainly imported from Germany; and galvanised iron netting and painted screens from the United States of America and Belgium. The first factory in Delhi was put up towards the close of 1942, and their number has now risen to 32. The aggregate number of looms installed in these factories is 207 and they find employment for nearly 250 workers.

Gold and Silver Foil. Gold and silver foil finds diverse uses in industry, e.g., for gilding metals, wood, stone and leather, for painting and interior decoration and production of illuminated pictures, lettering and ornamentation of book bindings, preparation of mirrors and fancy leathers for shoes, besides forming an ingredient in indigenous medicinal preparations. In pre-war days, the industry provided employment to over 1,400 men spread over in about 300 workshops. As a result, however, of the unprecedented advance in the prices of gold and silver, and the consequent fall in demand, nearly two-thirds of the workers have left the industry and sought employment in other trades.

Sola Hats. Delhi has recorded phenomenal progress in the sola hat industry during the war years. With its monthly output of 6,500 dozen sola hats, it now vies with Calcutta in commercial production of medium quality hats and with Bangalore, the other important centre in India, in the elegance of better class qualities. The pith, rings and matting for lining are imported from Calcutta; the cloth used is of Indian mill manufacture with a small proportion of English woollen gaberdine for superior varieties, and the leather straps and buckles are of local make. The industry provides employment to over 400 workers of whom nearly 95 per cent. are from Calcutta.

Woodware Industries.

Cabinet manufacture is by far the most important branch of wood working trades of Delhi and recorded a very large measure of progress due to the location of numerous civil and military Departments in this city during the war years. 60 of the more prominent establishments of furniture manufacturers have a capital investment of Rs. 11,46,000 and find employment for over 1,800 skilled and unskilled workers. Most of them executed large Government orders for office and house-hold

furniture. Innumerable new designs were introduced in the trade, the most outstanding features of which have been the importing of a stream-lined effect and the substitution of inlay work with a wood of a darker hue to relieve the monotony of the smooth surfaces in place of embellishment by carving, which besides being costly appears to have gone out of fashion. Besides cabinet work large Government supplies were made by local concerns of wooden boxes, stretchers, camp furniture parachute containers, barrows, runners for tents, etc. A few small scale enterprises were set up for the production of gaily painted fret-work toys for children, shoe lasts, models of warships for military training schools, bodies for lorries and trucks, embroidery frames and pen holders. There are in addition two organised factories, one for the production of perambulators and toy tricycles and the other for indoor games. A noteworthy line in this industry is that of *Jahezi Sandook* or dowry boxes which are delicately painted over in traditional designs mostly in black and gold on a white ground and form part of the dowry of Muslim brides.

Leather goods. The leather goods industry occupies the second position among the cottage industries of Delhi with an annual production valued at about Rs. 1,75,00,000. The industry finds work for nearly 6,000 men of whom 3,250 are hereditary *chamars* engaged in the production of indigenous types of *jootis* in the famous Salem Shahs style and *chaplis*; 250 engage in the production of ladies fancy hand bags, purses and money bags while the rest work in organised *karkhanas* for the production of English type boots and shoes, and other leather goods like suit cases, attaché cases, hand bags, etc.

There are innumerable shapes and varieties in the indigenous footware styles of which the description given in the *Delhi District Gazetteer* (1912) holds true even today and will be read with interest: "Connected with the gold and silver wire trade is the considerable trade in embrodiered shoes for which Delhi has long been celebrated. The variety of patterns and shapes is remarkable even in a country where phantasy runs riot. Nothing could be prettier or more dainty than some of the slippers, (*zanana juti*) made for native ladies' wear embroidered with seed pearls, usually false, with spangles and every variety of gold and silver thread; and inlaid with red, black or emerald green leather in decorative patterns. Gilded and silvered leather are also used. Sometimes gold and silver embroidery is worked on cloth over a basis of leather. Men's shoes are often no less elaborate". Some of the organised factories are well equipped with modern machines and tools and implements like sole pressing

and treadle sewing machines, heel fixing machines, canvas joining machines and equipment for the production of dubbing protectives. The prominent among them executed large Government orders during the war years for such leather and allied goods as gloves, jerkins, *poshteens*, *chhaguls*, haversacks, camp equipment, etc. One of the local concerns has earned a country-wide repute as producers of leather trunks, portfolio cases, hand bags, etc., while a few others produced new items to Supply Department specifications as mosquito boots for nursing sisters, white canvas rope soie shoes, flying knee boots, antigas boots, belts and valises. A firm of Chinese bootmakers of New Delhi introduced wedge heels in mens' crepe sole shoe swhile another progressive local concern has designed a shoe with a jointless upper, and a footwear which can be turned into a boot or a slipper at the will of the wearer.

Tanning Industry. There is no modern tannery in Delhi. A small amount of tanning is done in cottage establishments by the "bag tanning" process. Of the 55 such establishments, 30 are concerned with the tanning of hides and the rest with tanning of skins. The total number of persons employed in the industry is about 225. The tanned hides of Delhi are, however, considered superior to Madras hides and sell at a premium of Rs. 2 to Rs. 3/- per maund while the tanned skins are of an inferior quality and are used locally for the uppers of *desi jootis* and in-soles of boots and shoes and for book binding.

Glue. Delhi has 2 medium scale and 4 small glue factories whose aggregate daily production amounts to 2 tons. The two larger concerns which are well planned on modern lines made large supplies of their glue to Government purchasing department during the war years.

Conclusion

It only remains to say in conclusion that in common with other important industrial centres in India, the further expansion of manufacturing activities in Delhi was arrested mainly due to short supplies of raw materials and fuel, and restricted transport for the import of new machinery and export of finished goods. While the cessation of Supply Department orders, in their immediate effect, resulted in the closure of a few factories and restricted production in a few others, the resumption of operations in them to their full capacity to meet the pressing demand of civilian requirements can be achieved if sufficient quantities of raw materials are made available to them at economic rates.

UNIVERSITY OF DELHI

The University of Delhi was incorporated as a unitary teaching and residential University by an Act of the Central Legislature in 1922 The original conception of a unitary teaching University had however, to be given up gradually in favour of that of a Federal University. Subject to the control and coordinating influence of the University, the Colleges remain as autonomous teaching units, working in co-operation with each other and with the University itself.

In 1933 a memorable step was taken in the development of the University on these new lines. The old Viceregal Lodge, with its extensive gardens was handed over to the University, and sites were earmarked for the constituent colleges in the area known as the old Viceregal Estate, by the Government of India on condition that each constituent college should be prepared to forego some measure of its autonomy in order to share in, and contribute to, the life and government of the University as a whole.

Since then the authorities have been anxious to facilitate the move of the constituent colleges to the new site and the development of the University into a federal University.

St. Stephen's College has already moved to its new buildings in the immediate neighbourhood of the University. The Hindu College has started its building operations on the site allotted to it to the south of St. Stephen's College. It is hoped that other colleges will follow St. Stephen's College and Hindu College in their move to the new site in the near future.

Recent Activities

In spite of the difficulties created by the War, the development of the University during the last few years has been phenomenal. The old Viceregal Lodge which now houses the University has been completely renovated ; three quadrangles of the new Science Building have been completed, and a separate building for Biology Laboratories is nearing completion ; the Law Building has been reconstructed and amply extended to meet the requirements of the University Law School ; the University Hall for the residence of non-Collegiate, Post-graduate and other students has been further extended ; a Cricket Ground is being prepared in the central area of the University and other playing fields not far from the University are being made ready for use ; the University Library has been re-organised and other improvements are being effected in different directions.

Seven Professorships have been provided of which five Professors have been appointed -two in the Faculty of Arts, two in the Faculty of Science and one in the Faculty of Law. The Science teaching staff has been strengthened by the appointment of several new lecturers.

The following new Departments of Studies have been instituted and are functioning :

(i) A Department of Russian Language ;

(ii) A Degree Course in Nursing Science ; and

(iii) A Post-graduate Degree Course in Library Science.

Post-graduate and Honours courses have been instituted in almost all Arts subjects and also in Physics and Chemistry and arrangements are being made for more adequate laboratory facilities and the extension of the Library.

Of all the reforms and improvements introduced in the University in recent years, the most important is the Three-Year Degree Course, now finally adopted by the University. Although the scheme has long been advocated by many prominent educationists and various academic authorities in this country, Delhi has had the proud position of the pioneer by taking the first courageous step alone in this direction. It is perhaps too early to estimate correctly the far-reaching effects of this educational experiment ; but it should have two immediate results at least : namely, improvement of Secondary schools and raising of the standard of school instruction on the one hand, and a more effective and worthy University education on the other.

From what has been said above it will be evident that the University is now passing through a transition stage in which things begun are gradually taking shape. Much that is being done may, therefore, give an impression of confusion and the crudeness of unfinished work. But the foundations have been well laid, it is hoped, and future years will show the actual achievements.

Buildings.

The old Viceregal Lodge is now the central building of the University; it houses the University Library and Offices and provides accommodation for Meeting and Committee Rooms, several Lecture Rooms and one Senior Common Room for teachers.

The Law building, which is popularly known as the Prince's Pavilion, was originally constructed as a residential building, but has now been reconstructed and adapted to its present requirements. The open Courtyard in the middle has recently been roofed over to provide accommodation for the Law Library and Reading Room. Two wings have recently

been added to it, one on each side, to provide additional lecture accommodation.

The Faculties

There are at present four Faculties in the University, namely, Arts, Science, Law and Medicine, of which Science and Law are directly under the control of the University. The University appoints and maintains the teaching staff and provides the other teaching requirements in these Faculties. Teaching in the Faculty of Arts is provided chiefly by the colleges, but is supplemented by a staff of teachers appointed and maintained by the University. The Faculty of Medicine has come into existence only recently.

Colleges

There are six Degree Colleges in the University, of which one is for women. The numbers of students in the different colleges on January 1, 1946, are as follows:

	Name of the College.	*No. of Students.*
1.	St. Stephen's College	477
2.	Hindu College	800
3.	Ramjas College	284
4.	Anglo-Arabic College	183
5.	College of Commerce	548
6	Indraprastha College for Women	346
7.	University Law students	522
8.	Students in the Russian Dept.	265
	Total	3,425

Subjects Taught

The following subjects are taught in the University and its constituent colleges.

Faculty of Arts.

English; Oriental Classics—Sanskrit, Arabic and Persian; Modern Indian Languages—Urdu, Hindi, Bengali and Panjabi; History; Mathematics; Philosophy; Economics; Commerce; Geography; Library Science; Russian.

Faculty of Science.

Physics; Chemistry; Biology; Mathematics; Nursing Science.

Faculty of Law.

Jurisprudence; Civil Law; Criminal Law and Evidence; Hindu and Mohammadan Laws.

THE ALL-INDIA RADIO

Installation of Transmitters

Broadcasting in India was started in an organized form in July 1927 by the *Indian Broadcasting Company*. When Government took over broadcasting in April 1930, only two medium-wave transmitters, one in Bombay and the other in Calcutta, existed to serve the listeners in the whole of India, the transmitters being 1.5 K. W. each. As this service was obviously very inadequate, a special grant of Rs. 40 lakhs in two instalments was obtained for the development of broadcasting in India. A 20 K.W. medium-wave transmitter was installed in Delhi early in 1936. Two Departments, the Installation Department and the Research Department, were established early in 1937 to handle the work involved in the establishment of more broadcasting centres.

The scheme drawn up for the development of broadcasting out of the first 40 lakh fund provided for the establishment of four 10 K.W., S.W. regional centres at Delhi, Bombay, Madras and Calcutta, and four 5 K.W., M.W. centres at Lahore, Lucknow, Trichinopoly and Dacca. Madras was to have a 0.25 K.W., M.W. transmitter to serve the city. The scheme also provided for the improvement of the studio facilities at Delhi, Bombay and Calcutta. Further, Delhi was to have a 5 K. W., S. W. transmitter for internal news service.

Due to the limited funds available at start, it was the intention to start with a satisfactory second grade service covering the whole of India, and to expand the second grade service to a first grade service as and when conditions and finance permitted.

Four weeks after the Department was started, orders were placed for ten transmitting units and a heavy burden was immediately thrown on the Department in carrying out the preparations involved in the establishment of so many broadcasting centres, which in each case, included the choice of a suitable site for the transmitting station, the acquisition of land, the construction of a transmitter station building, arrangements for power supply, arrangements for telephone connections, installation of transmitting equipment, modifications of rented buildings to be used for studios, the acoustic treatment of studios and installation of studio technical equipment.

Five months after the orders were placed for the transmitters, the first transmitter was erected on 1-6-37,—a 5 K.W., S.W. transmitter at Delhi, and six months later, two new stations were opened simultaneously on 16-12-37.,—a 5 K.W., M.W. station at Lahore with five acoustically

treated studios and a 10 K.W., S.W. station at Delhi. The last of this series was erected at Dacca and came up for service on 16-12-39.

The Patna broadcasting centre was also added to the list subsequently, but due to reasons beyond control, this station was not established; it is expected to function sometime in 1947.

At the beginning of the war, the importance of the Central News Service became manifest, and so a 10 K.W., S.W. transmitter was designed and erected departmentally at Delhi.

For purposes of relays, both from other networks of the A. I. R. (All-India Radio) and from the British Broadcasting Corporation (B. B. C.), receiving centres were projected for each broadcasting station, and the first centre at Delhi was established by the middle of 1937. Since then each broadcasting centre has been provided with a separate receiving centre.

In 1940, Government of India decided that the power of the Peshawar transmitter should be increased to 10 K.W. and the station converted to a full fledged broadcasting centre. Government also decided to establish a 100 K.W. transmitter station at Delhi for external service and the construction of a Broadcasting House, to handle the increased activities on this account. The Karachi project also was added to the list

The new Peshawar centre started functioning by the middle of 1942, and the 100 K.W. transmitter at Delhi by March 1944. A number of transmitters, five of them, all shortwave, were erected in Delhi between December 1943 and November 1945, on behalf of His Majesty's Government (H. M. G.)

Existing Network

The transmitters existing at the different centres are : —

1.	Delhi		20 K.W.	Medium wave,	*Marconi*	make
			10 ,,	Short wave,	*Philips*	make
			5 ,,	,,	*Marconi*	make
			10 ,,	,,	*A. I. R.*	make
			100 ,,	,,	*Marconi*	make
			100 ,,	,,	*I. G. E.*	make
		2 Nos:	20 ,,	,,	*S. T. C.*	make
		2 Nos:	7.5 ,,	,,	*R. C, A.*	make
2.	Bombay		10 ,,	,,	*Philips*	make
			1.5 ,,	Medium wave,	*Marconi*	make

3.	CALCUTTA	10	K.W. Short wave, *Philips* make
		1.5	„ Medium wave, *Marconi* make
4.	MADRAS	10	K.W. Short wave, *Philips* make
		1.5	„ Medium wave, *Philips* make
5.	PESHAWAR	10	„ Medium wave, *R.C.A.* make
6.	LAHORE	5	„ Medium wave, *Marconi* make
7.	LUCKNOW	5	„ „ „ „ „
8.	DACCA	5	„ „ „ „ „
9.	TRICHINOPOLY	5	„ „ „ „ „

Each of the nine centres above, has a receiving centre attached to it.

Shortwave Service

It has been stated that the initial aim was to provide a second grade service covering the whole of India.

The total area covered by a direct ray service from the medium-wave stations in existence will only represent a small fraction of the total area of India. At night time, the medium-wave stations provide an indirect ray service over a greater area than this, but still do not meet the requirement that a measure of service shall be given to the whole of India. A limitation to the indirect ray service of the M.W. stations is imposed by the atmospheric disturbances. The magnitude of these disturbances on the short-wave lengths is much less. A great increase in the indirect ray service area of a station is therefore obtained by operating a station on short wave-lengths. There is also the important consideration that a short-wave station can provide an indirect ray long distance service by day time, as well as by night time, whereas a medium wave station can only provide on indirect ray service at night time.

These considerations led to the establishment of the four 10 K.W., S.W. stations at Delhi, Bombay, Calcutta and Madras, so that with these stations in operation no part of India would be outside the range of a broadcasting station, but it is admitted that a short-wave service is only a second grade service and is only intended as an initial step in the broadcasting programme to provide some measure of service to the whole of India.

These short-wave transmitters were also intended to serve the area in which they are located and as such special aerials and wavelength changes have become necessary.

The post-war scheme envisages two different broadcast services,—an urban service in large cities and towns and over thickly populated areas

of urban character, and a rural service for the whole of India on two different sets of medium wave transmitters.

Transmitters, Aerials and Receiving Centres

(a) *Transmitters:*—The transmitters were erected by the staff of this department. It has been the practice to get the services of one of the engineers of the Company supplying the transmitter, his assistance being thus ensured during erection, and the transmitter was taken over after verifying that it conforms to the specifications. Of late, the complete erection and tests have been done by AIR engineers. The transmitters thus erected are:—

(1) 10 K.W. *RCA* Transmitter at Peshawar,

(2) Reerection of the 10 K.W. *Philips* Transmitter at Delhi and Madras,

(3) A good part of the four *Philips* 10 K.W. Transmiters and the *Marconi* 100 K.W. Transmitter,

(4) Two *STC* 20 K. W. Transmitters, and

(5) Two *RCA* 7.5 K.W. Transmitters.

(b) *Aerials:*—For the medium wave transmitters, the Company supplying the transmitters have themselves been made responsible for the erection of a suitable aerial and earth systems in most of the cases, after due scrutiny by this department that the aerials do conform to our requirements.

The short-wave aerials have all been designed and erected by this department.

(c) *Receiving Centres*: The equipments at the receiving centres have all been chosen and erected by this department.

The receiving diamond aerials have all been designed and erected by AIR engineers.

Technical

All the transmitters are upto *C.C.I.R.* specifications and incorporate interlocks for the safety of the equipment and operating personnel.

20 *K.W. Medium wave Transmitter at Delhi, Marconi make:*—

This is the only transmitter of AIR that employs series modulation. The final RF stage employs 4 Nos. water cooled *CAT*-6 valves and the final modulator stage employs 4 Nos. water cooled *CAM*-3 valves.

The drive is from a Franklin *L-C* compensated oscillator unit. There is also provision to make one of the early RF stages self-oscillate in case of failure of drive.

The high tension D.C. is drawn from 3 Nos. of water-cooled *CAR*-6 diode rectifiers.

There are running machinery for D.C. Filament power, bias and for water circulation to the high power valves. The filaments of all the main valves are D. C. heated except the *CAT*-6, which are AC-heated for obvious reasons.

The aerial comprises of 3 vertical elements of No. 6 wire suspended between two insulated stayed masts, each 100 meters high.

The service area of this transmitter is about 100 miles and the total power consumption is about 93 K. W. giving an overall efficiency of 20 per cent.

Regional Short-wave 10 *K.W. Philips Transmitters at Madras, Bombay, Calcutta and Delhi.* These transmitters use high level class B anode modulation and use water cooled valves for the final and penultimate R.F. stages and final L.F. stage. Two valves type *TA*12 20, OOO*K* are used in the final RF stage. Due to shortage of these in war-time AIR had to find out a substitute and at present a number of transmitters employ the *STC S.S.* 1971 valves instead of the *TA* 12,20, OO*OK*. There is provision for mounting two spare valves in position. The modulator stage employs 2 Nos. of *MA*12/15 valves and there is provision also for mounting two spare valves. The filaments of the main valves are D. C. heated, the supply being derived from a motor-generator. The other running machinery in the transmitter are the pumps for the circulating water and the blower to cool the water.

The drive is from a thermostat controlled crystal. The crystal chamber can accommodate 3 crystals and there is also a duplicate chamber. The transmitter can work on any frequency from 25 to 90 meters; and between transmissions the wave length can be changed in ten minutes.

The high tension D.C. is obtained from 4 Nos. of grid controlled hot cathode mercury vapour rectifiers, type *DCG* 10/15,000. These hot cathode rectifiers combine a high percentage of efficiency along with good regulation. The safety device used on this rectifier system is a unique type.

Even these valves had to be replaced by substitute valves, *STC. 4078GA*, in some of the transmitters, necessitating some alteration in circuit.

The service area of this transmitter is about 500 miles and the power consumption is 51 KW. giving an overall efficiency of 19·6 per cent.

Aerials: The aerials for each wavelength consist of a horizontal dipole provided approximately half a wavelength above ground originally and later modified to 7/16 wavelength above ground. The aerials are strung between suitable earthed masts. This is fed by a two wire transmission line which runs upto the centre of the dipole aerial. The transmission line is matched to the aerial, to avoid standing waves, by means of stubs and these stubs incidentally provide the static leaks for the transmission line.

5 K.W. Marconi Medium Wave Transmitter at Lahore, Lucknow, Dacca and Trichinopoly. These transmitters employ air-blast cooled valves in the final stages. The modulation is the high level class B anode type.

Four valves type *ACT*-9 are used for the final RF stage and four valves type *ACM*-1 for the modulator stage and all these valves are air-blast cooled.

The only running machinery are the blowers for air-blast cooling.

The filaments for all the valves except the final RF valves is D.C. heated, the supply being got from copper oxide rectifiers. The filaments of the *ACT*-9 valves are A.C. heated.

The transmitter is capable of operation on any frequency between 200 and 545 meters but each station operates on a particular frequency assigned to it. The drive is from a crystal but one of the early RF stages can be made to self-oscillate in case of failure of drive.

The High tension D.C. is obtained from air-cooled diode rectifiers 6 Nos. of type *MR* 10.

The service area of this transmitter is about 50 miles and the power consumption is 28 K.W. giving an overall efficiency of about 18 per cent.

Aerials: The aerial system takes the form of a single self-radiating lattice steel mast, insulated from ground, supported by six insulated stays and provided with a capacity top to increase the effective height of the mast. The physical height of the mast is 180 ft. and the electrical height is between $\frac{1}{4}$ and $\frac{1}{2}$ the operating wavelength of the respective station.

The earth system, which is very important for a medium wave radiator, consists of 120 radial wires, each of length approximately 3/8 the operating wavelength of the station. The aerial efficiency obtained with such a system is approximately 85 per cent.

5 K.W. Shortwave Marconi Transmitter at Delhi

This transmitter is similar to the medium wave transmitters but the main deviations are :—

(i) D.C. for the filaments of all the main valves is derived from a motor generator set,

(ii) 9 rectifier tubes, type MR10 are used for the main HT as against 6 in the medium wave transmitters.

The transmitter is capable of operating on any frequency between 14 and 100 meters, and 112·5 and 150 meters and employs class B modulation on the final power stage. The drive is from a *Marconi Franklin* compensated oscillator and is continuously variable. There is also the usual provision for self exciting one of the RF stages in case of failure of drive.

The power consumption and efficiency of this transmitter are the same as the 5 K.W. M.Wave transmitters.

The aerial commonly used with this transmitter is a *H*1/2/7/16 as this is meant to be relayed by all stations for news items.

250W Transmitter at Madras

This is the only transmitter using supressor grid modulation. This system, though less efficient than the high level class B, offers the advantage of a low power high voltage rectifier system being used.

The radiator is a stayed tubular mast of physical height 120 ft. and provided with a capacity top. Both the mast and stays are insulated. The efficiency of this transmitter is as low as 12·5 per cent. and the transmitter is meant to serve only the city of Madras.

The Shortwave Transmitters at Delhi for External Service.

Marconi 100 *K.W.* : The modulation is the high level class B type. The drive is from a crystal but a separate L-C master oscillator is provided as a stand-by. The freqūency of the transmitter is continuously variable from 13-90 meters.

The final RF stage uses 2 Nos. of water cooled *CAT*.17 valves and the final modulator stage uses 2 Nos. of water cooled *CAT* 20-*C* valves. There is provision for mounting a spare *CAT* 20-C valve in position. The sub-modulator stage and the penultimate RF stage use water cooled valves. The previous RF stage uses air blast cooled valves.

There is provision for a stand-by unit for delivering the High tension D.C. A steel tank mercury arc rectifier (*BTH* make) is used normally for the H.T. supply but in case of failure, H.T. D.C. is obtained from 5 Nos. of water cooled *CAR*-6 valves.

The filaments of the main valves are D.C. heated and a motor-generator set delivers the D.*C.* for the filaments.

There are additional rotating machinery for the bias supply, circulating water pump, secondary cooling pump and air-blast coolers.

The secondary cooling water is specially cooled in a secondary tower located outside the building.

The entire transmitter is located in two floors. A unique feature is the provision of trucks for wavelength changes and rail-system for moving them. By means of these, each truck can be kept tuned to a predetermind frequency and moved in when the wavelength change is to be made. The wavelength change takes 10 minutes approximately.

There are also carriages for shifting and changing the hefty final stage valves.

The power consumption is 300 K.W. giving an overall efficiency of 30 per cent.

The aerial system is described later for all the transtmitters.

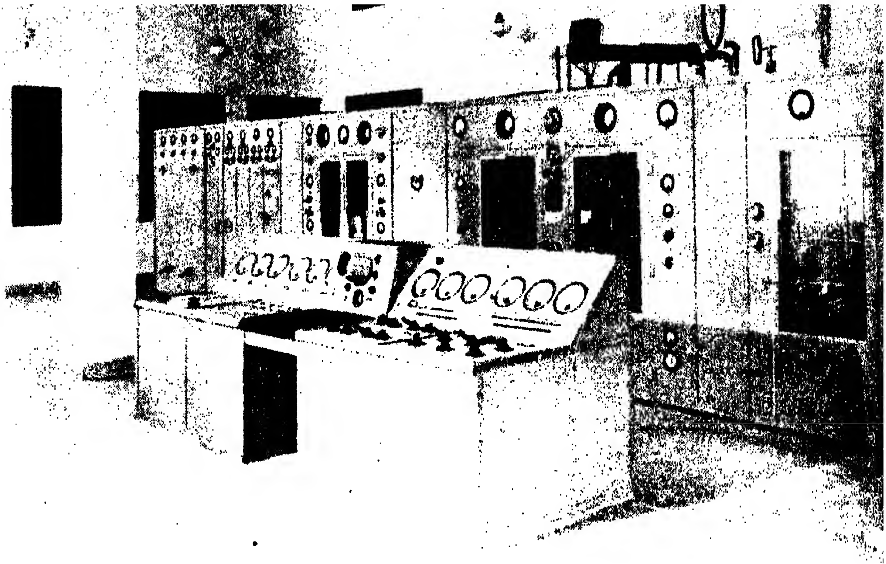
I G.E. 100 *K. W. Transmitters.* : This transmitter occupies just one big hall. It is very compact. The modulation is the usual High Power Class B type, and the drive is obtained from thermostatically controlled crystals.

The final RF stage uses 4 Nos. water cooled valves type 880 and the final LF stage 4 Nos. of 893 valves. The filaments of all the valves are AC. heated and the only running machinery in the transmitter are water pumps and blowers. Like the *Marconi* 100 K W. Transmitter this transmitter also uses primary and secondary water cooling systems but the secondary cooling system is inside the building itself and is very compact.

The main HT is obtained from hot cathode marcury vapour valve rectifiers type 857.

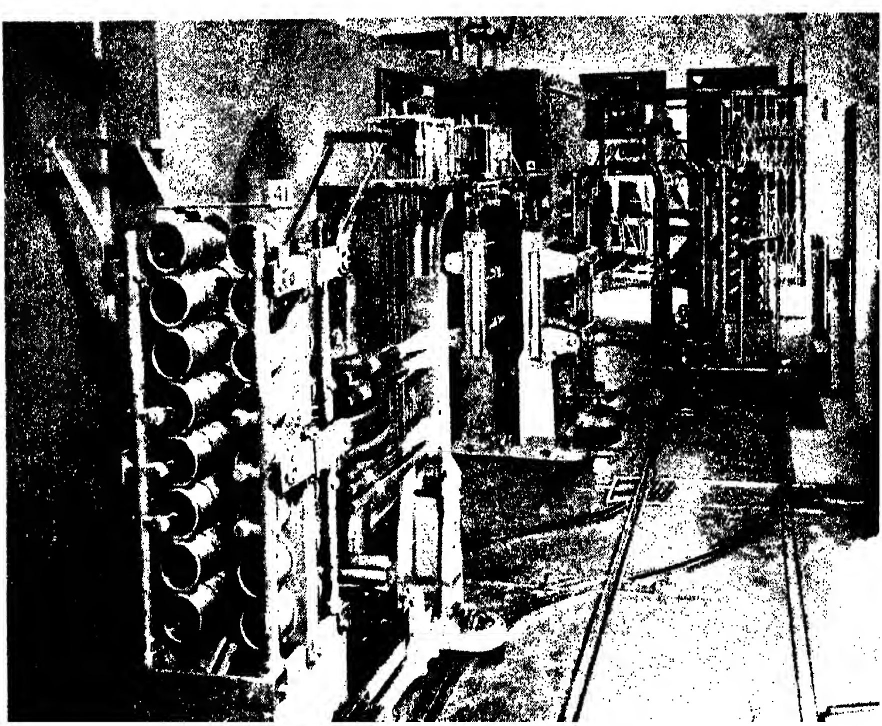
This transmitter is capable of operation only on certain wave-bands between 16 meters and 49 meters and the frequency of the transmitter is not continuously variable.

One rare feature is the use of water cooled coils for the tank circuit thereby minimising the size of the tank coils.



Marconi 100 K.W. Transmitter with control desk.—Front view

Wave change trucks and rail system for 100 K.W. Marconi Transmitter



A number of high speed relays are incorporated in the transmitter foa indicating faulty circuits. The feeders are directly tapped on the final tank circuit which is not the case with other transmitters.

The power consumption is 257 K.W. and the overall efficiency is over 35 per cent.

STC 20 K.W. Transmitters : These transmitters also use the high level class B modulation. The drive is from thermostat controlled crystals and a spare L-C master oscillator is supplied for use when the crystal oscillator fails. The frequency of this transmitter is continuously variable from 13 meters to 100 meters.

Four water cooled tetrodes type *4Q/230A* are used in the final RF stage and 2 Nos. *3Q/221E* triodes in the final L.F. stage. This is the first transmitter in AIR to use tetrodes in the final stage. There is provision for mounting a spare L.F. valve in position. Due to shortage of valves type 4Q/230A substitute *STC SS* 1971 valves had to be used for some time. The filaments of the main valves are D.C. heated. Some novel features of this transmitter are :

(*i*) Use of a turntable for choosing any one of *four* predetermined wavelengths in the final stage. The turntable accommodates both the tank coils and the feeder coupling circuits and is capable of operation from the front of the tansmitter.

(*ii*) The D.C. for the final valves is derived from metal rectifiers each rectifier delivering about 75 amps at 20 volts.

(*iii*) The early RF stages are inductance tuned.

(*iv*) There are 6 separate RF channels starting from crystal stage upto the penultimate stage. Each stage can be tuned to a particular frequency and left over.

(*v*) To correspond with the four tank circuits on the turntable there are four grid trays which can be withdrawn and replaced from front.

(*vi*) The insulating coils for the RF valves are laid longitudinally in trenches. The leakage current which gives an indication of quality of water circulating can be measured.

(*vii*) The only running machinery are the pumps and blowers.

(*viii*) The main H.T. D.C. is obtained from a unit consisting of 6 Nos. of 4079 G Grid controlled hot cathode mercury vapour rectifiers. A spare valve is mounted in position. This rectifier unit is quite robust. A spare rectifier unit has been provided for use with either transmitter.

(*ix*) Bias is all derived from metal rectifiers as also the auxilliary H.T. upto 800v.

The power consumption of this transmitter is 76 KW. giving an overall efficiency of over 27 per cent.

RCA 7.5 K.W. Transmitter : These use crystal drives and high level class B modulation.

There are 2 Nos valves type 889 *R* in the final RF stage, airblast cooled and 2 Nos. 891 *R* type valves in the final L.F. stage, also air-blast cooled. The airblast fans are mounted directly below the valves.

There are no running machinery besides the blowers. The filaments are all A.C. heated. Hot cathode mercury vapour rectifiers are used for obtaining the H.T. D.C. These are spot frequency transmitters and do not provide any facility for quick wavelength change. The frequency can be varied from 13 meters to 100 metres.

The feeders are tapped on the final tank coil and a π network is provided on the feeder circuit.

The transmitters occupy a very small space.

The power consumption is 30 k.w. giving an overall efficiency of over 25 per cent.

Aerial system for External Services

These ærials are spread out over an area of 90 acres and are connected with the transmitters by means of overhead transmission lines.

High Power Aerials : There are beams in three directions, and all the beams are bi-directional. The beams are East-West beams, North-East beams and the European beams. All of them are stacked horizontal arrays.

The East beams use* $H2/2/\alpha\lambda$, the North-east beams $H2/4/\alpha\lambda$ and the European beams $H4/4/\alpha\lambda$. The height above ground of the ærials, as indicated by $\alpha\lambda$ above, for the lower wavelengths are kept nearly λ and for other wavelengths not less than 0.5λ.

The elements of any one ærial are all fed in phase.

The feeder lines for the high power transmitters are 4 wire feeders of characteristic impedance nearly 300 ohms. The stray capacities have been

*In the notation $H\,2/2/\alpha\lambda$, H stands for horizontal arrays; the first term stands for the number of horizontal half wave elements in the aerial ; the next term stands for the number of similar vertical elements ; the last term indicates the height above ground of the lowest elements of the aerial in terms of wavelengths.

reduced to a minimum by increasing the space between conductors and earthed objects.

The impedance of the ærials also are brought to near about 200 ohms by duplicating the conductors in the case of the East-West beams and by introducing matching sections for the North-East beams.

The European beams have been slewed by 7.5°.

Though the feeder line impedance and the ærial impedance are nearly the same, matching is necessary on account of irregularities introduced in the transmission line. The method of matching is what is known as 'pinch matching'.

Since there are no static leaks anywhere on the line, $\lambda/4$ stubs are provided to act as static leaks.

The feeder lines from transmitters terminate on a main switching structure from where they can choose the particular ærial switching structure and at the ærial switching structure the particular ærial required is chosen. The selection is by means of switch arms which terminate in hooks and which engage eyes fixed on the outgoing side. The whole operation is done by means of specially designed poles.

A set of dipoles and local service ærials are also used by the high power transmitters. These are of the *Krauss* type wherein the conductor is multiplicated in a suitable way, to give the necessary impedance as also to distribute the power available.

These high power ærials are also used at times by the low power 20 k.w. and 7.5 k.w. transmitters.

Low Power Aerials: There are a set of beams $H\ 2/2/1\ \lambda$ only in the East-West direction and one beam in the European direction for 13 m. only. The feeder lines from the transmitters are open wire 600 ohms overhead lines and they are matched to the ærials by means of stubs which also act as static leaks.

As mentioned already, provision has been made to connect any of the four low power transmitters to any of the beams.

The network of high and low power feeders are carried on suitable supports, keeping the interaction between feeders to a minimum.

RCA 10 K.W. Transmitter at Peshawar.

This transmitter uses high level class B modulation. There are two airblast cooled valves in the final RF stage and 2 airblast cooled valves in

the final LF stage. This transmitter is similar to the 7.55 k.w. RCA transmitter installed at Delhi except that this is for medium-wave operation.

The ærial used is of the self-radiating type and is the highest used in India, being 350 ft. high. The mast is stayed and insulated and is made up of steel tubes. There is a suitable earth system for the radiator

The power consumed by the transmitter is 30 K.W. and the overall efficiency is 33 per cent.

Receiving Centres

The system known as the Space Diversity System is used for diversity reception at all the AIR centres. The receiving ærials used are the horizontal rhombic and there are 2 for each direction suitably spaced. Where land is not very costly, the ærial which gives the maximum amount of directivity is the Bruce Horizontal Rhombic. This ærial, in addition, is effective over a wide range of wavelengths. Two rhombic ærials are normally used in conjunction with a third ærial, which may be a horizontal doublet. These ærials are well spaced and feeders of the open overhead type carry the signal to the receivers.

The receivers used are of the *Hammerlund* type. The signal from the ærials are fed on to the receivers and the output is suitably combined to minimise the effect of fading. The output is then transmitted to the studios by means of telephone lines which are corrected for bad response.

Installation of A.I.R. Studios

The general policy of All Indian Radio has so far been to take a rented building and adopt it for installation of studios. This is in view of the limited funds that have been available for such purposes. As such no uniform plan could be worked out for all the stations of All-India Radio and the available rooms in the selected buildings have been suitably modified and acoustically treated to get the best quality of reproduction. The limitation in a rented building is usually due to the fact that no special measure, such as double walls for studio rooms, proper height of ceiling and selection of a suitable building in a central place of the city, but away from traffic noise, could be achieved to the desired extent. As a studio has to be sound-proof, special ventilation has to be provided. Out of the existing stations of All India Radio, Madras and Calcutta studios are air-conditioned by providing one cooling unit for each studio connected to a common compressor. In Bombay, where the studios are located in the Central Government Buildings, a central distribution system of air-conditioning

has been provided. In the other stations, forced ventilation by means of exhaust fans has been provided. The acoustics of a room of normal shape depends primarily upon its reverberation time which may be defined as the time taken, after the sources cease to emit sound energy, for the mean sound energy within the room to decay by 60 dbs. It varies with the frequencies of the sound and the reverberation time is measured at half a dozen representative frequencies, but ordinarily the reverberation at 512 cycles per second will give an idea of the acoustic behaviour of a room The reverberation time of a room ranges from a fraction of a second to several seconds depending upon the cubic contents of the room and the sound absorbing materials present therein. To get the best effect, speech or music must take place in a studio of optimum reverberation time and the idea of acoustic treatment of studios consists in so treating wall surfaces, ceilings, and floors with sound absorbing material as to bring the reverberation period to the optimum value.

In the earlier days, curtains were used in AIR studios but after a good amount of study and experiment, 'celotex', a vegetable fibre board, has been chosen as a proper material for the acoustic treatment. This material has been found to be satisfactory both from the point of view of decoration and acoustics. The absorption co-efficient of celotex (as in the case of most other materials) is low at low frequencies and high at high frequencies hence a certain amount of boom would be noticeable on this account. To reduce this about 2 3rds of the walls in the lower portion is treated with celotex fixed on wooden battens and the batten work is done in such a manner that they enclose small columns of air. The celotex sheets thus fixed act as resonant panels at low frequencies and thus absorb energy by vibration. In the remaining portion of the wall, celotex boards are fixed directly. The ceiling is treated with celotex if the same is very high; otherwise it is left untreated. Drugget or linoleum is used for flooring The studios are provided with one entrance and no windows. The entrance is provided with one single leaf sound-proof door which is made of celotex boards with air columns in-between and provided with observation holes. The only exception where AIR has its own studio buidings, is Peshawar. Here the building was exclusively constructed for accommodating the studios and offices. There are 5 studios for music, drama, gramophone records, talks and rehearsals and one control room for the speech input equipment.

The studios in Delhi were originally housed in a rented building in Old Delhi. These were extended due to two more S.W. Transmitters installed in 1937 and the inception of the Central News Organisation to

meet the growing demands, another building near the original studios was occupied for news broadcasts. But with the considerably increased activity during the war, the Broadcasting House was constructed with 13 studios, recording room, announcers' booths, etc. The site had to be very carefully selected and a central place was chosen very near the Imperial Secretariat and the Council Chamber in New Delhi. The studios are upto-date which are in no way inferior to those in U.K. or U.S.A. The building consists of a central tower with three wings which on their part are terminated in towers which are somewhat smaller than the central one. The Studio Block is enclosed within the South and North-West wings and is thus protected from the noise from the main roads on either side. The central tower and the three wings are occupied by the various offices of All-India Radio, namely the Directorate General, the News and External Services and the office of the Station Director, AIR, New Delhi In the basement are located the sub-station, the air-conditioning plant for the studio block and the three evaporative cooling plants for the three office wings and the echo room. The arrangement of the studio block is such that the main control room which is the nerve-centre of a broadcasting system is in the centre with all the studios and allied rooms grouped around it. 5 Studios out of 13 are intended for music and drama and are provided with independent announcer rooms and sub-control rooms usually called studio booths where the programmes from the respective studios and announcers' rooms are amplified and sent direct to the master control panel in the main control room which controls the swiching over to the outgoing lines to the transmitters. Out of the remaining studios, three are gramophone music studios, one is a talks studio and the others are used for broadcasting news and solo music. One studio is called the 'effects studio' which contains a number of gramo tables for mixing various effects simultaneously as and when required. This is also provided with materials for producing sound effects mechanically. Some of the studios are provided with store rooms and some are provided with large observation windows made of two glass panels to enable the studio booth engineer and the announcer to have a good view of the performance inside the studio. Wherever possible smaller observation windows are also provided.

As regards the actual construction, the studios have been constructed of heavy non-parallel walls to avoid the formation of stationery waves and flutter echoes. The studios grouped around the control room are broken up into three groups by two wide corridors on the right and left hand sides which further reduce the structural transmission of sound from one studio

to another. In the acoustic treatment, the aim has been to make the studios most modern and artistically pleasing. For this purpose, only celotex boards could not be used in all the studios. Glass silk with perforated transite board for covering has been used in a number of studios as the absorbent material. Glass silk or Euphon Quilt is made from glass drawn from flexible fibre possessing a high tensile strength It has got a high sound and heat insulating value. It is generally available in rolls of 27 yards long, one yard wide and 3/4″ thick. The surface to be treated is laid out with batten work and the enclosed air space filled with glass silk in two or three layers as required; made into quilts of proper size of 4′ × 2′ × 1/8″ thick are fixed over it. Thus only half the area of the absorbing material is effective.

The actual ceilings of the studios are hidden behind the false ceilings of glass silk backed with transite boards about 2 ft. or so below the former. This helps to reduce the reflection between the floor and the ceiling and secondly to cover the supply air-duct laid inside between the actual and the false ceilings. In the corridors, false ceilings made of celotex are provided, the supply ducts running in the intervening space between the false and the actual ceilings.

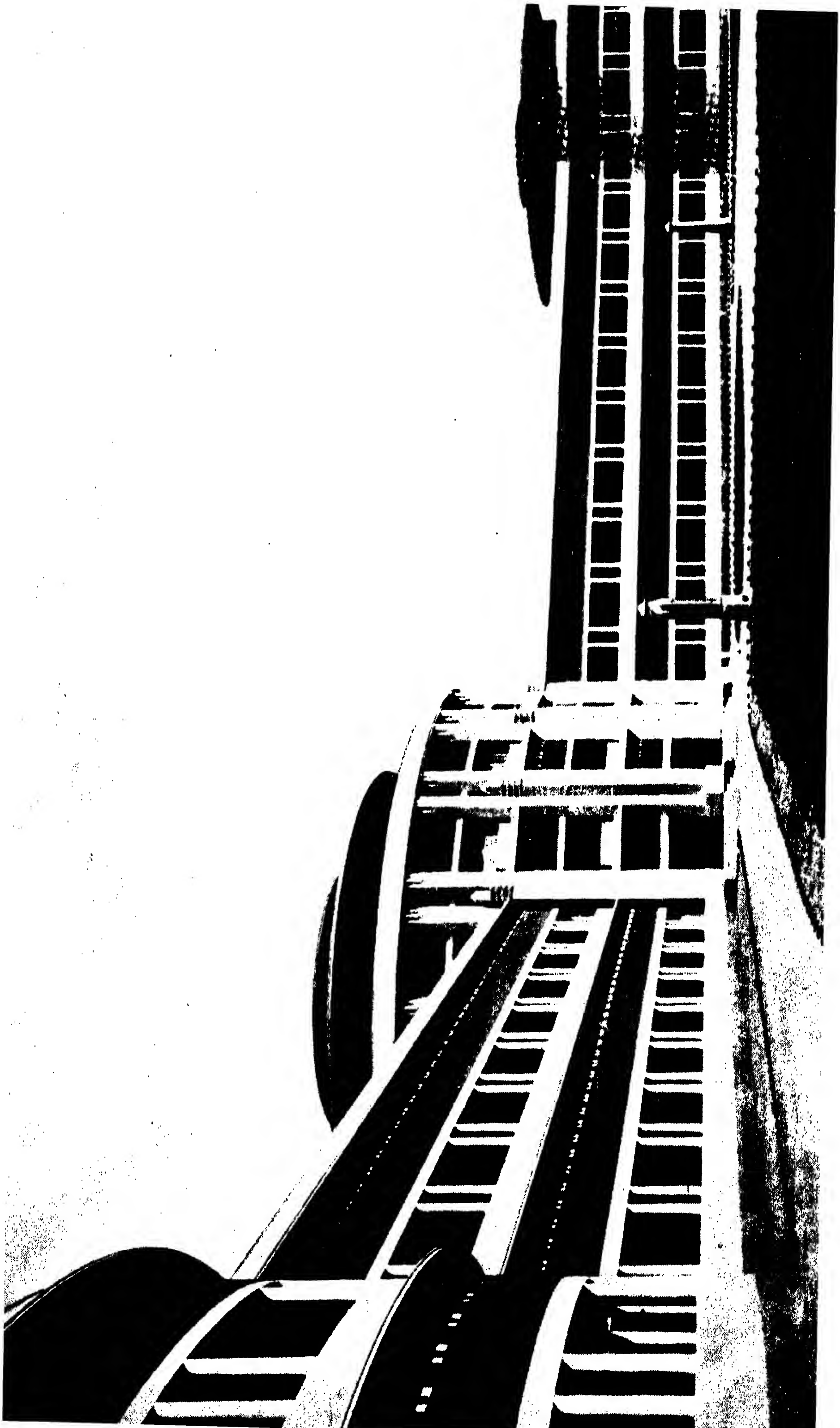
The studios and the associated places are pleasingly illuminated and flush type ceiling fittings covered with ground glass arranged symmetrically are used in all the big studios, while bowl fittings are employed in the smaller studios. Ceilings fittings of smaller diameter are used in the announcer rooms, studio booths and the corridors.

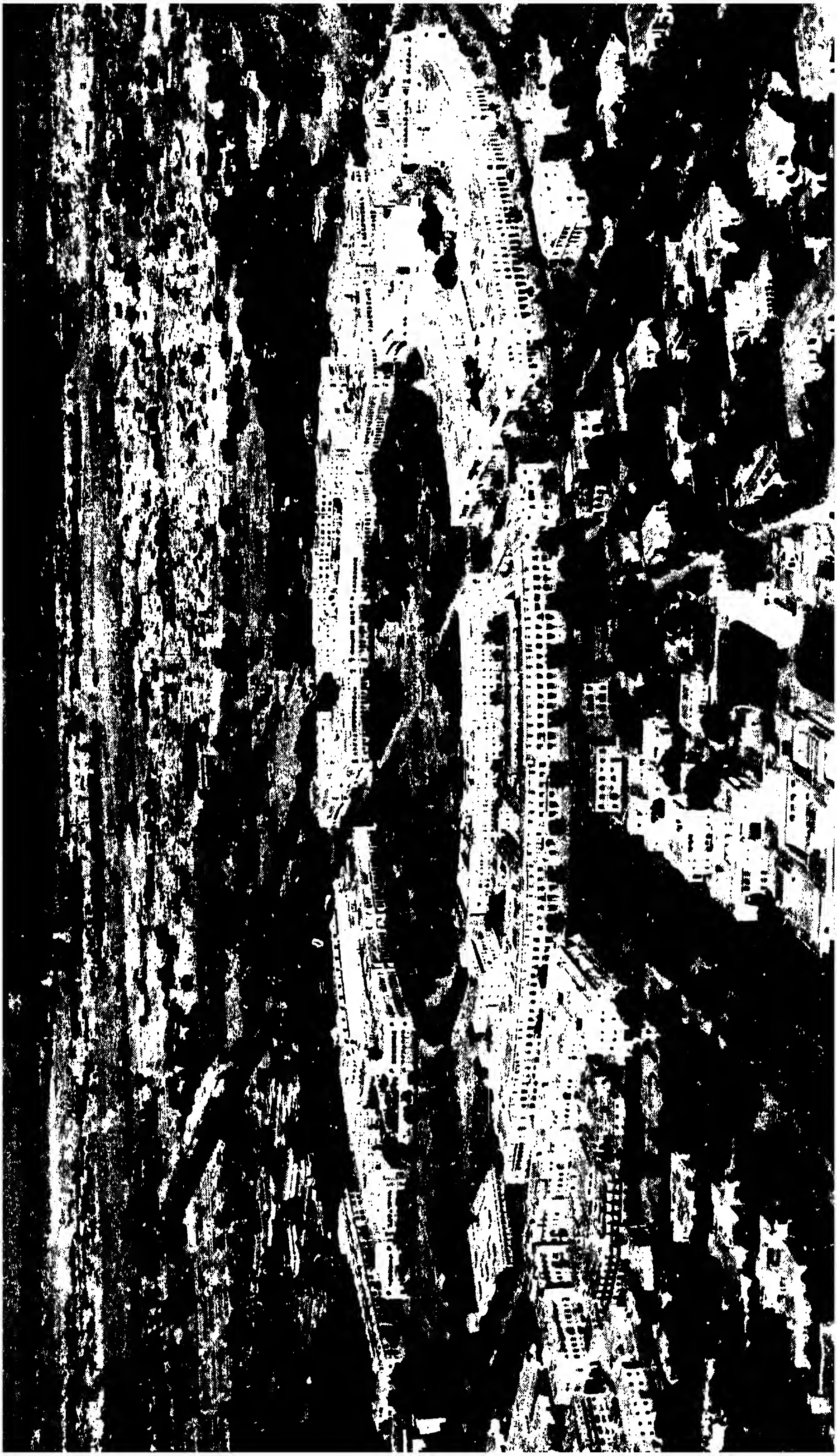
The studios are painted wherever necessary. Thus the absorbing pillasters are painted with Mattkote of light shade and the remaining bare walls are distempered to match the same shade. The doors are also painted with enamel paints of various shades. For the flooring, linoleum 3/16″ thick of green and brown colour have been used.

Equipment

The studios at the centres outside Delhi are about half a dozen in number each and hence a speech input equipment consisting of 6 pre-amplifiers into which the microphone output from the various studios are fed two or three main amplifiers and one or two monitoring amplifiers is provided. The output of the main programme amplifier is connected through suitable line pads to the transmitter lines. A mixer control is also provided with the main amplifier to control the pre-amplifier output level so that

Broadcasting House—A close up, showing the drive and main entrance →





the final output into the outgoing line of the transmitter does not exceed a particular level.

Suitable signalling facilities between the studios and the control room are also provided. Monitoring facilities both inside the studios and other rooms are provided by means of loudspeakers fed from monitor amplifiers.

Electric clocks are provided in all the studios. Dual gramo turntabler are used in gramo studios for continuous reproduction. Electrical recording units with immediate play-back facility are provided in each place.

In the Broadcasting House the master control system is a unique one by means of which automatic change-over from one programme to another is effected whether it is feeding one outgoing line or more than one. The system is designed for 13 in-coming programme lines and 6 out-going lines to one or more of which any one of the former can be automatically connected by pressing a key on the control panel.

For each programme lines and out-going line, one relay is provided. Thus, there are $13 \times 6 = 78$ relays provided in the switching circuits.

The dramatic control panel is provided to link up more than one studios where there is a drama or a feature demanding a number of actions or items at the same time which is not possible from one studio. Echo facility and effects filter for producing effects are also provided.

Aerial view of
Connaught Place

THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The inauguration of the Council of Scientific and industrial Research in 1942 is a landmark in the progress of science in India, representing an important, positive and conscious effort to promote national welfare through scientific knowledge. During the short period of its existence, the Council has brought home to the public in general, the importance of scientific research in nation-building activities. The development of over 100 industrial processes, the planning of seven National Laboratories and the initiation and completion of several surveys of raw materials and industrial resources of the country, are but a few of the Council's achievements.

Origin

The organization of industrial research, although much discussed in the past, did not receive the attention it deserved until 1935, when the Industrial Research Bureau was established by the Central Government under the Indian Stores Department, "to make a beginning and to lay the foundations on which a research organisation suitable for the needs of the country could later on be constructed". At the outbreak of the War in 1939, many industries in India were faced with shortages of essential materials. Many sources of supply of finished products were cut off, and imports from others were greatly curtailed. Many commodities essential for the prosecution of the war could not be produced in the country. The vast mineral, forest and other forms of natural wealth could not be harnessed immediately to meet the demands. Planned industrial research on the many problems of chemical, metallurgical and engineering industries was almost completely lacking. The need for the establishment of a central research organisation became manifest, and the Board of Scientific and Industrial Research was inaugurated by Government in 1940. The Industrial Research Bureau was kept in abeyance and its functions were amalgamated with those of the Board.

The activities of the Board were supplemented by the Industrial Research Utilisation Committee which was set up in 1941, "to advise on ways and means for the commercial development of the processes evolved under the auspices of the Board".

The experience gained in the working of the Board during the period 1940-42, suggested the desirability of enlisting the enthusiastic co-operation and support of non-official agencies in the country, and the Council

of Scientific and Industrial Research was inaugurated in April 1942 as a Registered Society. A Fund called the 'Industrial Research Fund', with an annual non-lapsable grant of Rs. 10 lakhs from the Central Revenues, for a period of 5 years, was created by Government and placed at the disposal of the Council. Although the Council does not stand on all fours with the Department of Scientific and Industrial Research in the United Kingdom, it is comparable to it in being the quasi-official organisation primarily responsible for industrial and scientific research in India.

The aims and objects of the Council are :—

(*a*) the promotion, guidance and coordination of scientific and industrial research in India including the institution and the financing of specific researches ;

(*b*) the establishment or development of and assistance to special institutions or departments of existing institutions for scientific study of problems affecting particular industries and trade ;

(*c*) the establishment and award of research studentships and fellowships;

(*d*) the utilization of the results of researches conducted under the auspices of the Council towards the development of industries in the country;

(*e*) the establishment, maintenance and management of laboratories, workshops, institutes and organisations to further scientific and industrial research, and to utilise and exploit for purposes of experiment or otherwise, and discovery or invention likely to be of use to Indian industries ;

(*f*) the collection and dissemination of information in regard not only to research but to industrial matters generally;

(*g*) publication of scientific papers and a journal of industrial research and development; and

(*h*) any other activities generally to promote the above objects.

The Council has two standing Advisory Bodies, which have been already referred to, *viz.*, the Board of Scientific and Industrial Research and the Industrial Research Utilization Committee. The Hon'ble Member in charge of the Industries and Supplies Department is now the *ex-officio* Chairman of both the bodies. He is also the President of the Governing Body of the Council.

The Board consists of 20 members. Among them, 10 are scientists, holding eminent positions in their respective fields. Four represent

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, INDIA.
Organisation.

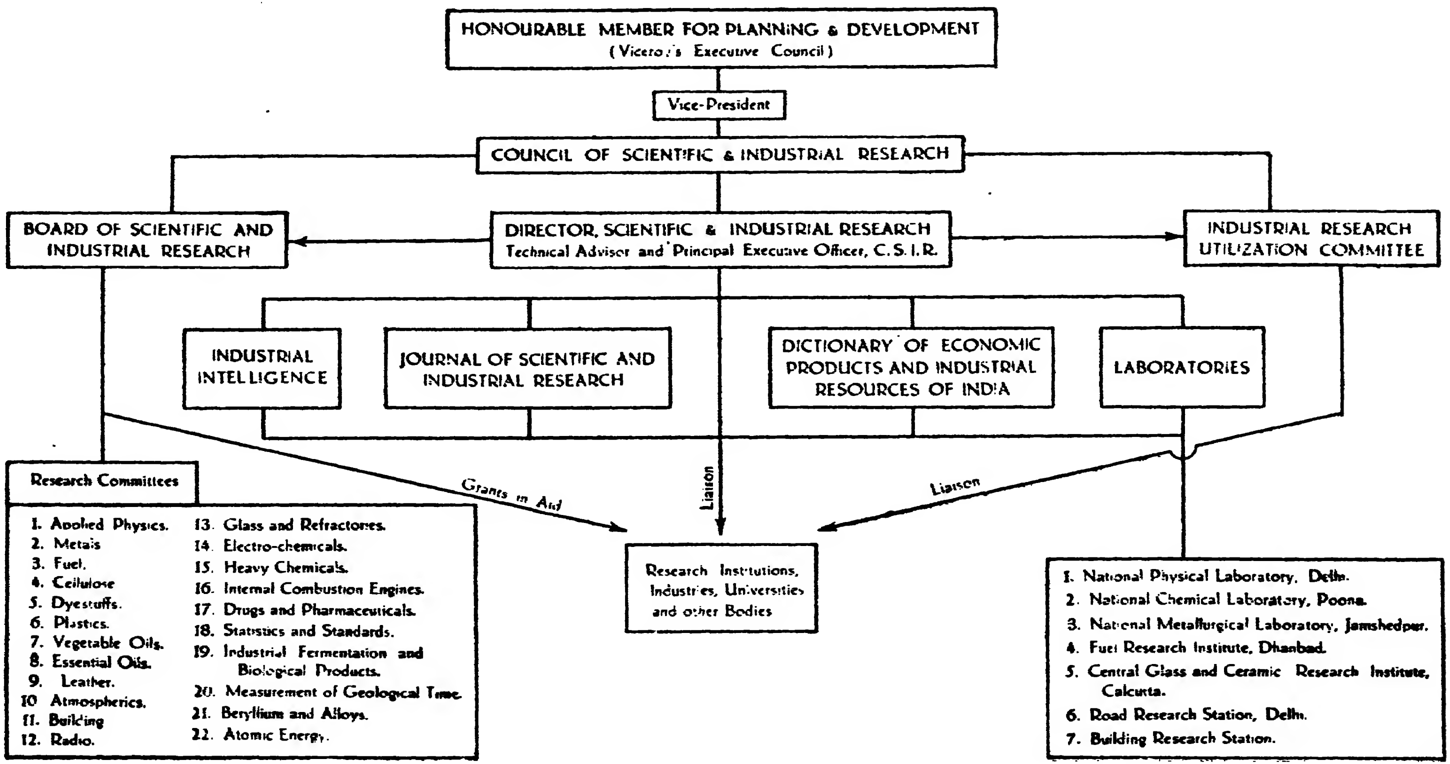


FIG.

Government Departments particularly interested in industrial research; the remaining members being leading industrialists.

The Board is assisted in its work by a number of Research Committees. All research schemes submitted to the Council for grants are referred to the appropriate Research Committee for examination and report. The Committee watches the progress of the schemes falling within its scope and formulates coordinated proposals for further research. There are 22 Research Committees of the Board.

The organisation of the Council is schematically represented in Fig. I.

Research Activities

The investigations at the Council's laboratories have brought to the forefront the industrial potential of the country and the possibilities for the utilization of her resources in fruitful and enduring lines. The gigantic proportions which the war assumed brought about an acute shortage of metals all over the world, and the need for substitute materials in many fields where metals were traditionally employed, became insistent. A large variety of plastics were developed to replace metals in many industries. The raw materials required for synthetic resins not being available in India in any appreciable quantity, indigenous materials were investigated in the laboratories of the Council with considerable success and many processes were developed for utilising them in industry. Jettison tanks and petrol-proof plastic containers were produced from jute and shellac; begasse plastics were developed for utilization as light building materials; shellac and jute were used in the manufacture of laminated boards, non-metallic containers, identity discs and insulating materials; horn waste plastics were developed for electrical appliances, collapsible tubes were made from castor oil and tailors' wastes; enamels, lacquers, varnishes and plastics were developed from *Bhilawan* (Indian marking nut), and vegetable oils were utilised for the manufacture of oil plastics.

The development of lubricants and internal combustion engine fuels from vegetable oils are two instances of processes worked out in the Council's laboratories for the utilisation of natural resources to meet the needs. Thousands of gallons of vegetable oil lubricants were produced in the country during the war years, and the processes were disclosed to China and other Allied countries.

The process successfully developed in these laboratories for the purification of Baluchistan sulphur was of considerable value in retrieving the serious sulphur position in India during the war.

With the establishment of close cooperation between the Director of Scientific and Industrial Research on the one hand, and the Defence Organizations of the Government, the R.A.F. and the U.S.A. Air Forces on the other, many problems of immediate importance to the prosecution of the war received attention in these laboratories A successful formula was worked out for the manufacture of anti-gas cloth from entirely indigenous materials and the process was revealed to Allied countries. Large quantities of the cloth were manufactured in India. High tension ignition cable testing device, slushing varnishes for petrol storage metal tanks, patching cement for the repair of rubber tanks petrol-proof hose-pipes, petrol containers, petrol pump diaphragms, petrol-tank sealing compositions coloured smokes and distress signals, hot food containers, water detecting compositions and shock-proof packing materials were worked out for the Air Forces. Pyrethrum antimalarials were prepared for Armed Forees in the South East Asia Theatre of War. Air foam fire extinguishers and luminous paints and pigments were developed. Several scientific devices, e.g. secret compass, were developed for the Military Intelligence Section.

Many industrial processes such as synthetic fibres from oil seed cakes, chemo-therapeutic products from vegetable sources such as *nim*, *brahmi*, *kakra singi*, *bhilawan*, etc., semi-synthetic tanning materials, insecticides from indigenous sources, rubber from *Cryptostegia grandiflora* and natural resins have been investigated and, results of far-reaching importance have been obtained.

Among the problems connected with the glass and ceramic industries which have been investigated are those connected with the production of optical glass on a pilot plant scale and the purification of glass making sands.

The Industrial Fermentation Research Committee has sponsored investigations on the utilization of molasses for the production of organic acids and solvents. An important activity of the Committee is the National Collection of Type Cultures.

Processes have been developed for the preparation of dyes from Indian vegetable sources Dye extracts from *Butea frondosa*, *Mangiferra indica*. *Acacia arabica*, *Terminalia tomentosa*, *Terminalia arjuna*, Annato, etc. have been prepared and their suitability as substitutes for synthetic dyes belonging to the Indanthrene and Alizarin groups has been established. Annato dye extracts are suitable for colouring food products.

Investigations on the washability of Indian coals, desulfurisation, low temperature carbonisation and physical and chemical survey of Indian

coals are being conducted under the auspices of the Fuel Research Committee. A full scale coal washing pilot plant has been set up in the coal-bearing area of Dhanbad.

α-cellulose bearing materials useful for the rayon, paper and plastic industries, have been surveyed, and optimum conditions for kier-boiling and bleaching have been established. *Etta* bamboo has been found to be the most economical raw material for rayon manufacture. Processes for the preparation of alkali and ether-soluble ethyl cellulose have been investigated.

Processes for the manufacture of butadience, titanium dioxide, carbon disulfide, phenol and other heavy chemicals have been worked out. The development of a process for the manufacture of phosphatic fertilisers from Indian mineral phosphates is an important contribution to the fertilizer industry.

Glandular products from slaughter house wastes, organo-arsenical compounds, antimalarials, synthetic drugs and active principles of a large number of Indian medicinal plants are a few to the research projects sponsored by the Pharmaceutical and Drugs Committee. Processes have been developed for the manufacture of adrenaline, pituitrin and thyroid extracts from slaughter house wastes.

The cultivation of essential-oil-bearing plants and the methods of extraction of the oils are being investigated by the Essential Oils Committee.

Problems connected with the manufacture of magnetic alloys, copper-silicon bronzes, aluminium-titanium alloys and resistance alloys of various types have been investigated by the Metals Research Committee. The metallurgy of beryllium and the manufacture of beryllium master alloys are being investigated by a special committee of experts.

The Applied Physics and Radio Research Committees have investigated a large number of problems, especially the manufacture of compressors, vacuum pumps and refrigeration machinery, X-ray tubes and Kenotrons, transformers and electrical meters, electro-acoustical and high frequency apparatus, manufacture of cheap radio sets, survey and production of insulating materials and dielectrics for high frequencies and other aspects of radio industry.

Over 150 research schemes have been financed by the Council in various universities and research institutions entailing an annual grant of Rs. 8 lakhs. Finances have been provided for the establishment of a Leather Technology section by the Madras University, and a Synthetic Dyestuffs Section by the Bombay University.

Although in the initial stages, applied research featured prominently in the activities of the Council, fundamental or 'pure' research has not been neglected. A large number of schemes of pure research have been initiated in the universities and research institutes, the more important among them being : atmospheric research, measurement of geologic time, electrical properties of typical order-disorder alloys, spectroscopic investigations on fuels and the mechanism of combustion. Substantial financial assistance has been given by the Council to the Tata Institute of Fundamental Research in Bombay, Palit Research Laboratory of the University of Calcutta and other research centres for fundamental research.

Journal and Dictionary

The publication of the Journal of Scientific and Industrial Research and the compilation of a Dictionary of Economic Products and Industrial Resources of India are among the important activities of the Intelligence and Information Service of the Council. News relating to important developments in scientific and industrial research in foreign countries, original articles on investigations carried out in research institutes in India, review articles on recent developments, non-technical notes on industrial processes, information on Indian patents, reviews of scientific and technical publications, etc., are published in the monthly Journal. The Dictionary of Economic Products and Industrial Resources of India, now under preparation, will have a permanent significance. It will comprise sections on (a) Cultivated and Medicinal Plants, (b) Forest Products, (c) Animal Products,(d) Minerals and related materials, (e) Chemicals, (f) Industries and Industrial Resources, and (g) Economics and statistics. The resources of the Indian Empire as well as of Burma and Ceylone will be surveyed and the Dictionary will deal with all economic products and raw materials of industries including processed materials and also some of the more important imported raw materials.

Research Utilization and Patents

The Industrial Research Utilization Committee advises the Council on ways and means for the expeditious and profitable exploitation by industry of processes evolved under the auspices of the Council. On completion of an investigation, a non-technical note giving details of capital and equipment required, availability of raw materials market prices and estimated cost of production, etc , is prepared. The process is then offered to industry for commercial utilization under specified conditions.

The Council has so far leased out 31 processes for commercial exploitation to private industry. These represent but a few of the inven-

tions of the Council. There are some awaiting to be leased out, and a much larger number of direct war importance given over to Defence Organisations of the Government.

The practice of protecting results of industrial research through patents has been followed by the Council. More than 100 inventions evolved by research workers of the Council have formed the subject matter for patents, sealed or pending. The inventions are patented in British India and in Indian States, foreign patents are applied for in special cases.

National Laboratories

A capital grant of Rs. 1 crore has been provided by the Government of India towards the establishment of a chain of National Laboratories covering a wide field of research. The public have evinced keen interest in the Council's activities for furthering research and have responded generously to its call for support. Definite proposals have been formulated by the Council for the immediate establishment of a National Chemical Laboratory, a National Physical Laboratory, a National Metallurgical Laboratory, a Central Glass and Ceramic Research Institute, a Fuel Research Institute, a Building Research Station and a Road Research Institute. A few of the Laboratories are already under construction.

The National Chemical Laboratory will be largely concerned with fundamental and basic researches on the utilization of indigenous raw materials by industry. The processes developed in the Laboratory will be carried out to the pilot plant stage. The Laboratory will maintain close contact with research institutions and industry. It will provide full facilities for initiating major investigations involving large expenditure of money, beyond the means of universities and existing research stations.

The work of the Laboratory will be divided into seven main Divisions: (1) Inorganic Chemistry including Analytical Chemistry, (2) Physical Chemistry including Electro-Chemistry, (3) Chemistry of High Polymers, (4) Orrganic Chemistry, (5) Biochemistry including Biological Evaluation, (6) Chemical Engineering, and (7) Surveys and Intelligence.

The essential functions of the *National Physical Laboratory* will be: (*a*) Maintenance of and research on fundamental and derived standards; (*b*) Research on industrial Standards, *viz.* (*i*) Standards of quality, (*ii*) Standards of Performance, and (*iii*) Standards of Practice; (*c*) Investigations on raw materials for industries; (*d*) Standardisation of raw materials, processes and finished products; (*e*) Research on Processes; (*f*) Framing of and advice on specifications; (*g*) Scientific and Industrial Testing; and (*h*) Publications.

A beginning will be made with the following scientific sections (1) Weights and Measures, (2) Applied Mechanics and materials, (3) Heat and Powsr, (4) Optics, (5) Electricity, (6) Electronics and Sound, (7) Building and Housing Research, and (8) Hydraulics Research. In addition, facilities for chemical analysis will be provided in all sections.

The National Physical Laboratory will undertake research whieh broadly falls under the following three categories: (*i*) Research on Standards, (*ii*) Research in Applied Physics, and (*iii*) Fundamental Scientific Research.

The functions of the *National Metallurgical Laboratory* will cover all aspects of matallurgical research, both fundamental and applied. It will also deal wiih researchs on ores, minerals and refractories.

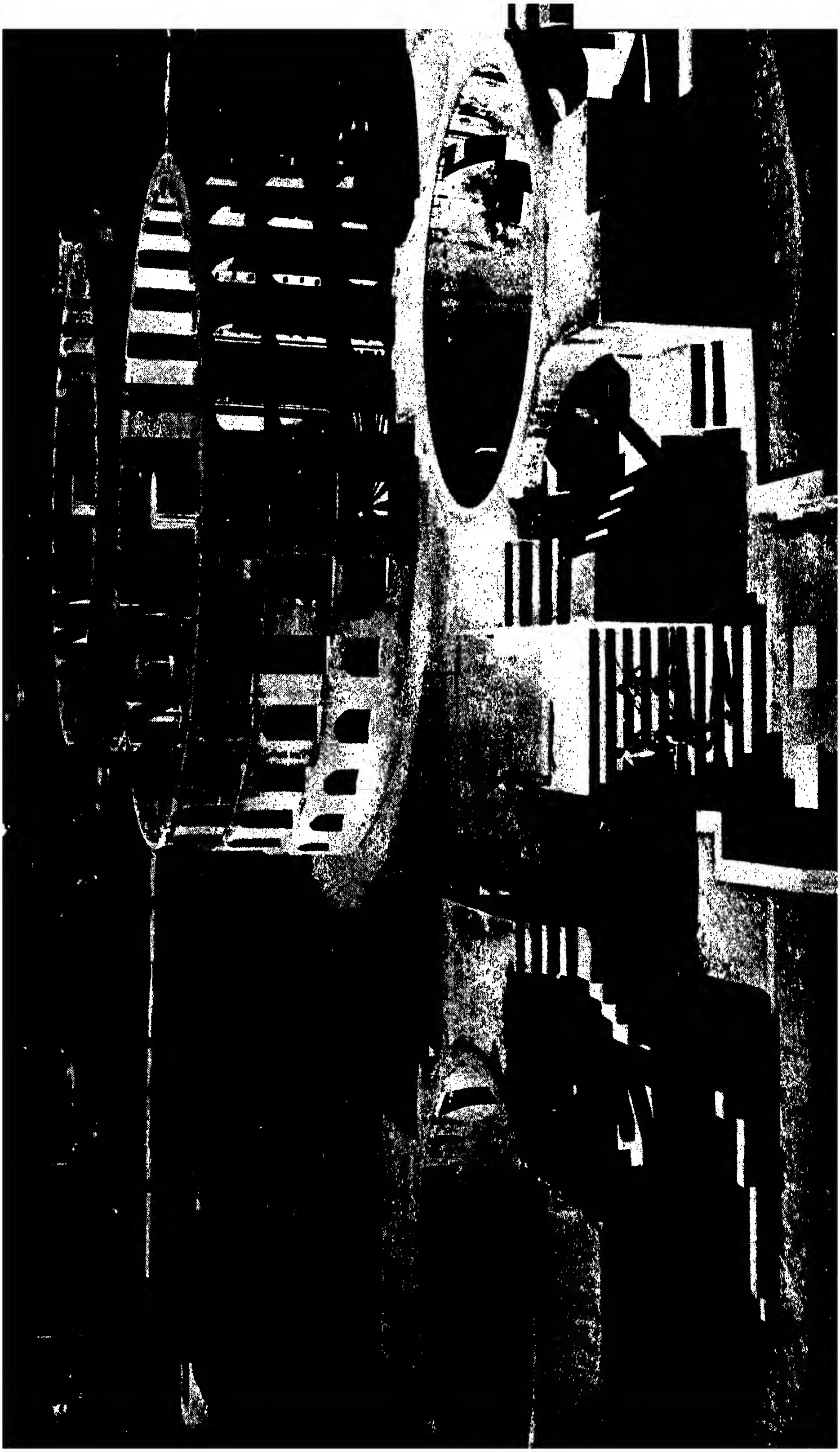
Facilities will be available for studies under commercial operating conditions and for the study of such conditions as they affect the quality of the products and the efficiency and economy of production.

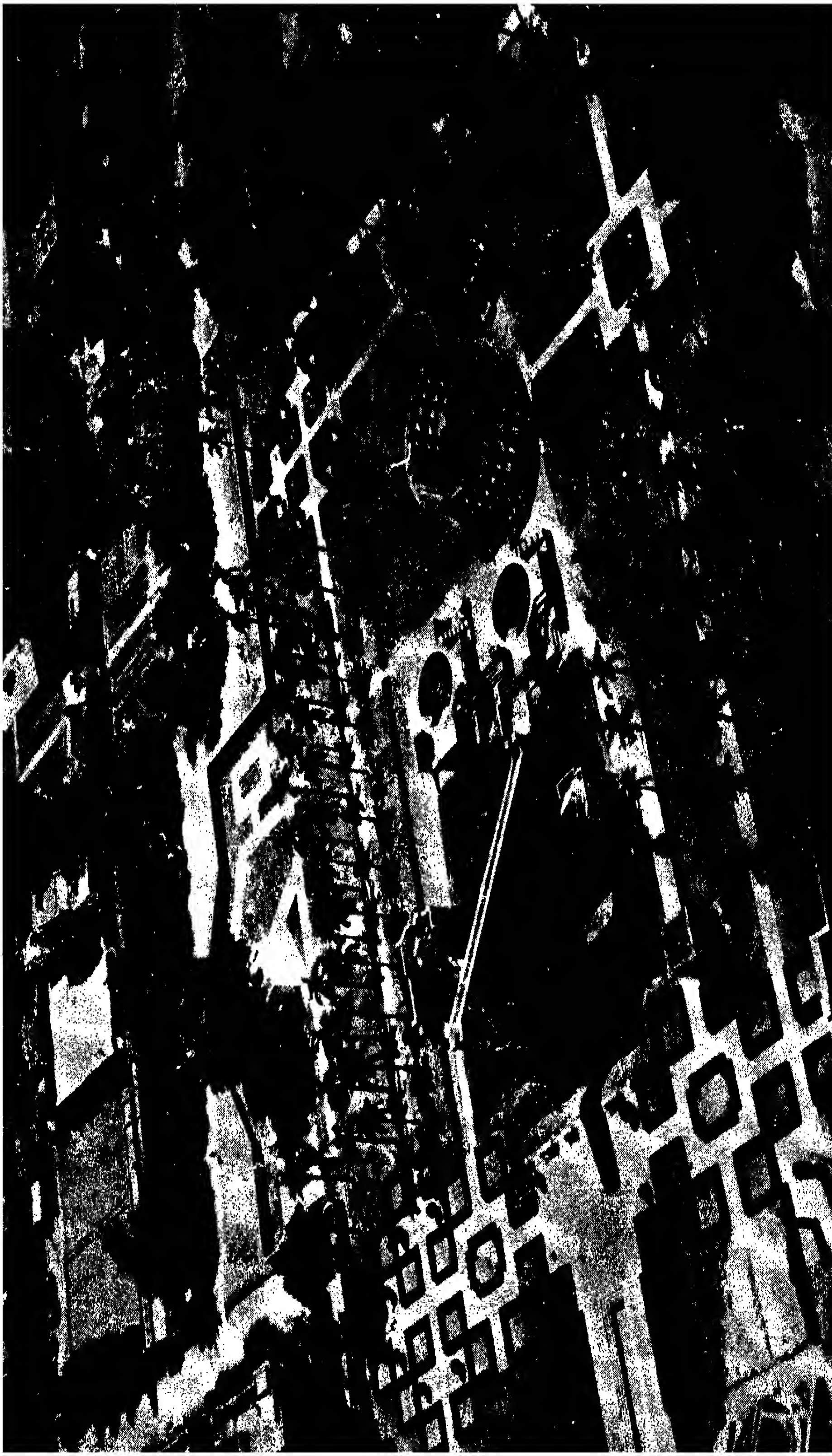
The functions of the *Fuel Research Institute* will be to promote and develop all aspects of fuel technology. Full facilities will be available for research on fundamental and applied aspects, and an information bureau for the collection and dissemination of information on fuels will be organized.

The Institute will undertake immediately a short-term programme of research, which includes a rip survey, washability of coal, coking and blending, gasification and road tars. The long term programme consists of detailed surveys, deterioration of coal on storage, de-ashing, nature of products of low and high temperature carbonisation, steam raising, pulverised fuel, briquetting, hydrogenation, liquid and gaseous fuels, specifications, tests and fundamental research.

The work of the *Glass and Ceramic Research Institute* comprises (*i*) Fundamental research having a bearing on different branches of glass and ceramics (2) Testing and standardisation, and (3) Dissemination of scientific and technical information. Problems connected with the efficiency of furnaces and annealing will engage the immediate attention of the Institute. While fundamental research is given importance in the activities of the Institute, particular emphasis will be laid on industrial research and the development of new processes. In the early stages, the Institute will confine itself mainly to standardisation and development, *i.e.* introduction of new processes. It is proposed to initiate a full survey

A close up of Jantar-Mantar, New Delhi →





of raw materials in collaboration with the Geological Survey of India. The Institute will have fully equipped sections for researches on glass, pottery and porcelain, enamels and refractories, and furnaces.

Final plans for the Building Research Station and the Road Research Institute are being prepared.

Research Planning

The Industrial Research Planning Committee set up by the Council in 1944 has made detailed proposals for the development of scientific and industrial research in India on the basis of a 5-year plan involving a block grant of Rs. 6 crores from the Government. The Committee recommends the setting up of a National Research Council which will be responsible for the direction and control of scientific and industrial research in India. Its immediate tasks will be: (1) the building and equipping of National Laboratories and specialised research institutes totalling 11; (2) providing grants-in-aid to Universities for strengthening and developing their scientific departments, and (3) training of research personnel for staffing the National Laboratories and special Research Institutes, by the award of scholarships and fellowships tenable in India and abroad. The Committee has recommended also the creation of a National Trust for Patents as a self-contained unit affiliated to the Council for the purpose of holding and exploiting all patents arising out of researches financed by the Government, and also patents voluntarily dedicated to it by private individuals or institutions on agreed terms. The formation of a Board of Standards has been recommended for research on Standards and for drawing up Indian Standard Specifications. To maintain the continuity in the Council's activities after the initial period of 5 years, the Committee recommends that the Government should provide an annual grant of Rs. 1 crore to the Council, and that the industry should be asked to contribute an equivalent amount to be realised by the levy of a statutory cess of 1/16th of one per cent on the value of production of industries run on factory basis. A contribution from the gross earnings of railways on the same percentage basis is also suggested. The setting up of Cooperative Research Associations has been recommended as an essential measure for the development of industries on scientific lines.

The above recommendations of the Industrial Research Planning Committee are now receiving the active consideration of Government and the recently constituted Planning Board.

← Oblique view of Jantar Mantar, New Delhi

ORGANIZATIONS FOR RESEARCH AND DEVELOPMENT
UNDER THE DEFENCE SERVICES IN INDIA

by
Dr. R. S. Thakur

In this article, the Defence Services Research and Development Organizations and their functions are described under the following heads :-

A : The Master General of the Ordnance in India.

B : The Director of Medical Services.

C : The Engineer-in-Chief.

A. The Master General of the Ordnance in India

Director of Technical Development, the three Controllers and their responsibilities : At the present time facilities for research and development in the Defence Services are concentrated mainly in the military organisation of the Director of Technical Development under the Master General of the Ordnance in India. The responsibilities of this organization cover the entire field of army equipment and are divided principally into three main categories, namely, Armaments, Mechanical Engineering and General Stores. In each of these the executive control is in the hands of a Controller of Development under whom operates a Headquarter staff and a number of developmental establishments suitably dispersed in different parts of India. The Controller of Armament Development is responsible for research and development, technical advice to the General Staff and inspection of manufacture of production and of purchased stores relating to weapons, ammunition, range-finding and signalling stores and a number of subsidiary and allied items. The Controller of Vehicle Development has similar responsibilities in regard to both fighting and load carrying vehicles and to mechanical engineering stores for army purposes. The Controller of Stores Development exercises similar responsibilities in respect of textiles, clothing and personal equipment, harness, saddlery, leather work, general stores of all kinds and the many problems connected with their storage and preservation.

Proximity of the Laboratories and Workshop to Ordnance factories: The establishments operating under the Director of Technical Development through the medium of the Controllers comprise both engineering workshops and scientific laboratories requisite to the performance of their

several functions. In the majority of cases, these establishments are located in the same area as the Ordnance Factory with whose outturn they are principally concerned, the geographical position of the factory determining that of the developmental establishments. This has been found beneficial in that production facilities can be directly taken into account in the event of any approach to any developmental problem and a close liaison be established between the designer and the authority who will later be required to undertake production. It has alse been found by experience that many research and developmental problems are brought to light through matters arising from the inspection of factory outturn. The laboratories operating under the Director of Technical Development perform the dual role of inspection and research, although they were primarily designed and equipped for the former function.

Technical staff and their duties: The staff of the technical developmental establishments are partly military and partly civilian according as their special technical requirements can best be obtained. Although before the last war they were primarily engaged in performing duties of inspection and the maintenance of technical data regarding army equipment, the recent years have seen a considerable expansion of these functions to include a quantity of research and developmental work directly associated with the military problems with which they are concerned.

Adaptation of Weapons and Equipment to Indian Conditions: The sphere within which original design of military equipment can be successfully attempted in India is still limited by the industrial capacity, particularly in regard to electrical and mechanical engineering. But a considerable amount of equipment designed elsewhere than in India has been found to require modification in order to enable it to operate under the climatic and other conditions obtaining in this part of the world with which the original designer was insufficiently familiar. This necessitates the very extensive trial of such equipment under the local conditions and the development of suitable alterations which after full trial and test both technically and in the hands of troops, can be recommended to the original designing authority for incorporation. Such duties form an important part of the responsibilities of the Director of Technical Development in ensuring that military equipment produced in Britain and elsewhere, upon which the Indian Armed Forces must at present rely for operational use, will give satisfactory and reliable service under the conditions in which Indian troops may be required to operate.

Pest control and Tropic-proofing : In the sphere of chemistry and of textile and leather technology, there is more scope for original contribution to equipment development and in particular as regards methods of combating the attacks of mould growth and insect pests which cause so great a wastage and destruction to many types of materials under Indian conditions. A great deal of work has been done in this respect at the Ordnance Laboratories, Cawnpore, from which a number of brochures have been produced describing the methods of stores preservation found to be effective against a number of destructive agencies. Work of a similar nature in connection with optical instruments has been conducted over a period of years in the optical instruments section of the establishments under the Controller of Armament Development and anticipated to a marked degree the findings which emerged during the recent war from similar work then organised in other countries principally in Britain, Australia and in the U.S.A. A final answer to the important problem of dealing with deterioration of optical instruments due to filming and fungus has not yet been found and work is still continuing.

Usefulness to Civil Industry : Although the majority of the items under development in technical developmental establishments are necessarily linked with military requirements, the foregoing will show that others are of more general application and of potential assistance and interest to civil industry. A list of the various establishments together with a brief summary of their responsibilities is given in the Appendix and the officers in charge are always glad to welcome interested visitors and show them at first hand their organisation and the nature of their activities provided reasonable notice is given beforehand.

B. The Director of Medical Service

The Organization of Military Medical Research in India. On the outbreak of war it was realised that the Military Medical Services were not sufficiently well equipped to carry out extensive research work owing to lack of trained personnel and equipment.

The first major problem encountered was the high incidence of malaria during the Burma campaign. The next was the high incidence of anaemia among Indian troops particularly vegetarians.

Such was the inadequacy of the pre-war organisation within India itself, that it was not until early 1942 that an administrative anti-malaria organisation was set up. In certain overseas Commands this was antedated

by a year or eighteen months. Had the foundations been laid before the war, the catastrophic casualities from malaria during the Burma campaign might not have arisen.

During 1943 and 1944 with the arrival in India of trained personnel, research workers and adequate equipment obtained largely through lend-lease, it was found possible to organise medical research in India under two staff officers, —an Assistant Director of Pathology (Research) and an Assistant Director of Malariology (Clinical Research)—, who were appointed to the Medical Directorate. The following research teams were formed :—

Anaemia Investigation Team.
Penicillin Research Team.
Base Typhus Research Team.
Field Typhus Research Team.
Protozooal Dysentery Team.
Biochemical Research Team.
Parasitological Research Team.
Neuropathology Research Team.
Pool of lab. assistants for research work.
Malaria Research Unit (Clerical).

These teams continued to function as separate units until 22nd May 1945, when they were reformed into the G.H.Q. Medical Research Organisation. This organisation had a strength of 18 officers and 56 RAMC and IAMC other Ranks.

On the cessation of hostilities and the consequent reduction of personnel, the numbers have been gradually reduced until the proposed peace-time establishment of the research organisation has been reached ; this will consist of 8 officers and 23 IAMC other Ranks.

In addition to this G.H.Q. Medical Research Organisation there will be malaria and hygiene wings at the Army Medical Training Centre, Poona, to carry out research and teaching in their respective subjects. Training and teaching of research workers will be carried out at the Central Military Pathology Laboratory, Poona.

Military medical research in India is controlled by the Pathology and Malaria Advisory Committee for India on which are representatives of the Central Research Institute, Kasauli, and the Malaria Institute of India. Representatives of the Director of Medical Services, India, serve as members of the Indian Research Fund Association. The Assistant Director of Malariology is closely associated with the Controller of Developments and Supplies.

Research work carried out during the war.

(a) The investigation of anaemia among Indian recruits.

(b) Penicillin; typhus research at Imphal; Protozooal Dysentery.

(c) The possible transmission of Schistomiasis from West African troops harbouring infections.

(d) Neuropathology, with particular reference to arsenical eneephalopathy.

(e) Marasmus in repatriated Prisoners of War.

Research work into the above subjects has been completed and much valuable information has been obtained. In addition to the above, extensive investigations were carried out into the prevention of malaria. It was conclusively proved that one tablet of mepacrine per day acted as a satisfactory suppressive of malaria.

The practical application of repellants was closely investigated and has resulted in the production of the fish-net type repellant clothing. Insecticides have been widely investigated to ensure the most satisfactory results of their application.

Future Research Work: At the Pathology Advisory Committee meeting held on 18/19 November 1946, it was decided that research work would be carried out into the following medical problems —

(a) Continuation of investigation into the typhus group of fevers;

(b) Investigation into the value of proteolysed liver and folic acid in the treatment of anæmia;

(c) Investigation into the tropical skin diseases, with particular reference to fungoid infections;

(d) Investigation into the pathological and biochemical changes in cases of effects of heat.

At the meeting of the Malaria Advisory Committee held on the 20 November 1946, it was decided that the research programme of the malaria wing of the AMTC would be particularly directed towards the use of new repellants and insecticides (and other protective measures) under conditions peculiar to military requirements. A further function will be the investigation of epidemiology of malaria in and about military stations.

C. Engineer-in-Chief

The Contribution of the E-in-C's Branch to the development of scientific and engineering knowledge lies principally in the application of the work of civilian research establishments to military needs. With this end in view, the Branch is represented on committees concerned with research into Highway Engineering and Soil Mechanics and close contact is

maintained with the research laboratories and experimental stations working on these subjects.

Problems: During the war many novel problems of great urgency arose and it became necessary to undertake a certain amount of original work, particularly in connection with the rapid construction of roads and air fields. The two principal subjects developed were :—

(a) *Soil Stabilization.* Researches covered not only a study of Soil Mechanics and Analysis, but also the treatment of soils with bituminous or tamiferous binders, e.g. pectin and tamarind seed. For reasons of security, however, it was not possible to publish the results of these experiments.

(b) *Pre-bitumenized sheeting*, known generally as "P. B. S.".—The development, manufacture and use of the material is fully described in a monograph shortly to be issued by the E-in-C's Branch of G.H.Q.

Laboratories and Experimental Establishments :—The above investigations were carried out in a number of different places by various soils laboratories and experimental stations created for the purpose. Most of these have now closed down; at present only the following three establishments are working :—

(a) *An Experimental Section* at Roorkee, mainly concerned with modifications of military equipment to meet Indian conditions.

(b) *A Soils Engineering Laboratory*: equipped to undertake any soil investigation required in the field in connection with work being carried out under E-in-C's direction. One laboratory is at present located at Maithon (Damodar Valley) with a branch at Lalitpur (U.P.), where it is engaged on the analysis and control of soils for earth dams.

(c) *A Concrete Testing Laboratory*, now at Quetta, available for any concrete testing work needed in connection with military works.

The Proposed Engineering Research Station at Poona and its scope. It is now intended to absorb these three establishments into a new Engineering Research Station to be set up at Poona, under the control of a Research Committee composed of senior officers of the E-in-C's branch. The scientific work of the station will be in the hands of fully qualified research officers, the scope of whose work will include the following :—

(a) Research and experimental work needed for the application of building and constructional engineering knowledge to the needs of the Armed Forces, with particular reference to
   (i) Speed and economy in constructional methods,
   (ii) Use of indigenous materials, and

(iii) Best methods of employing labour.

(b) Study of the work of, and liaison with, other research institutions, both civil and military, Building Research Station, Road Research Institute, Forest Research Institute, Ordnance Laboratories, etc., in order to avoid duplication of work.

(c) Soil analysis required for engineering and building.

(d) Testing of airfield runways for new or reconstruction projects, employing principally the Westngaard method of analysis of stresses in rigid pavements.

(e) Concrete testing required in connection with works projects.

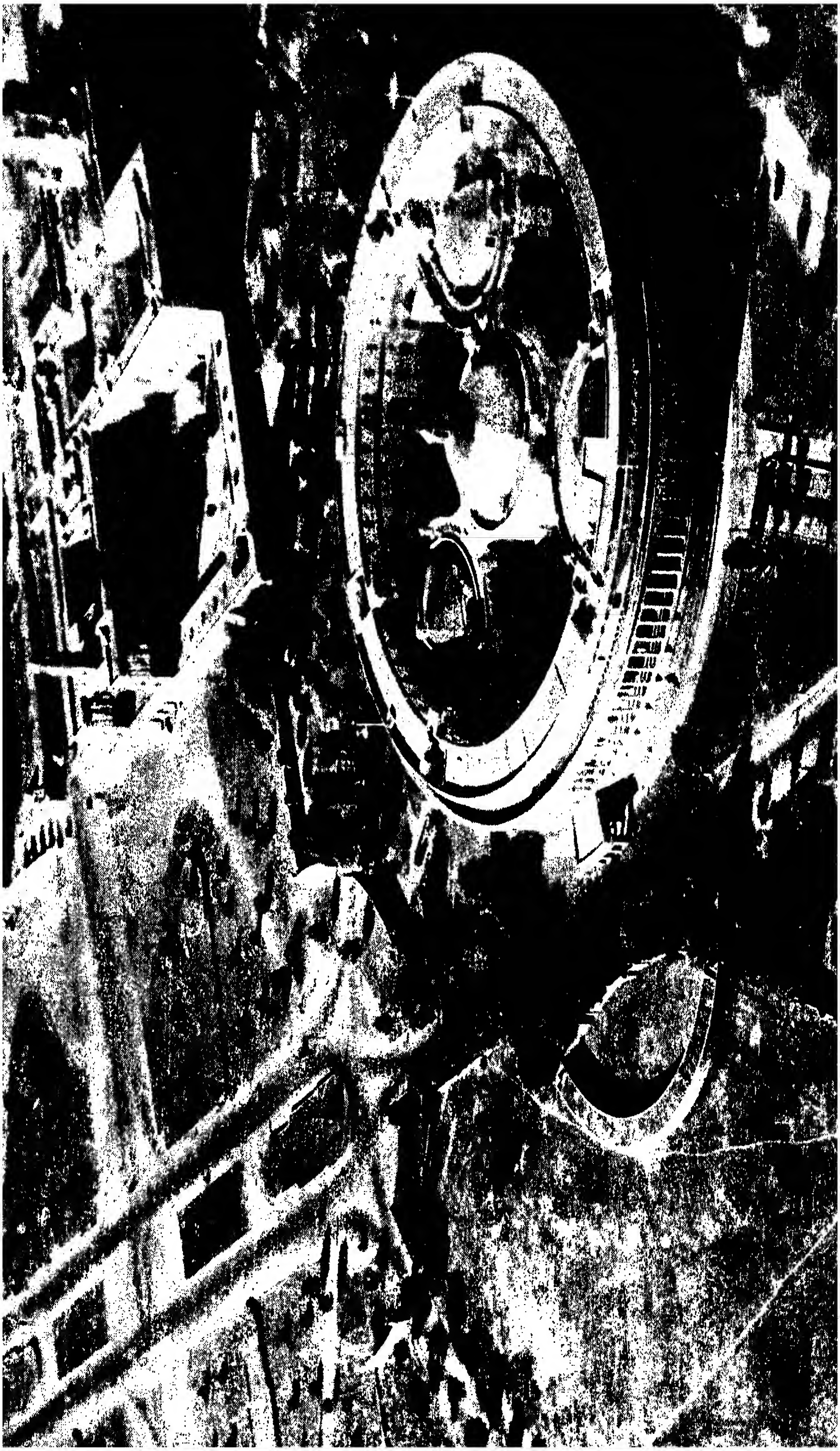
(f) Modifications of military engineering equipment to meet Indian conditions.

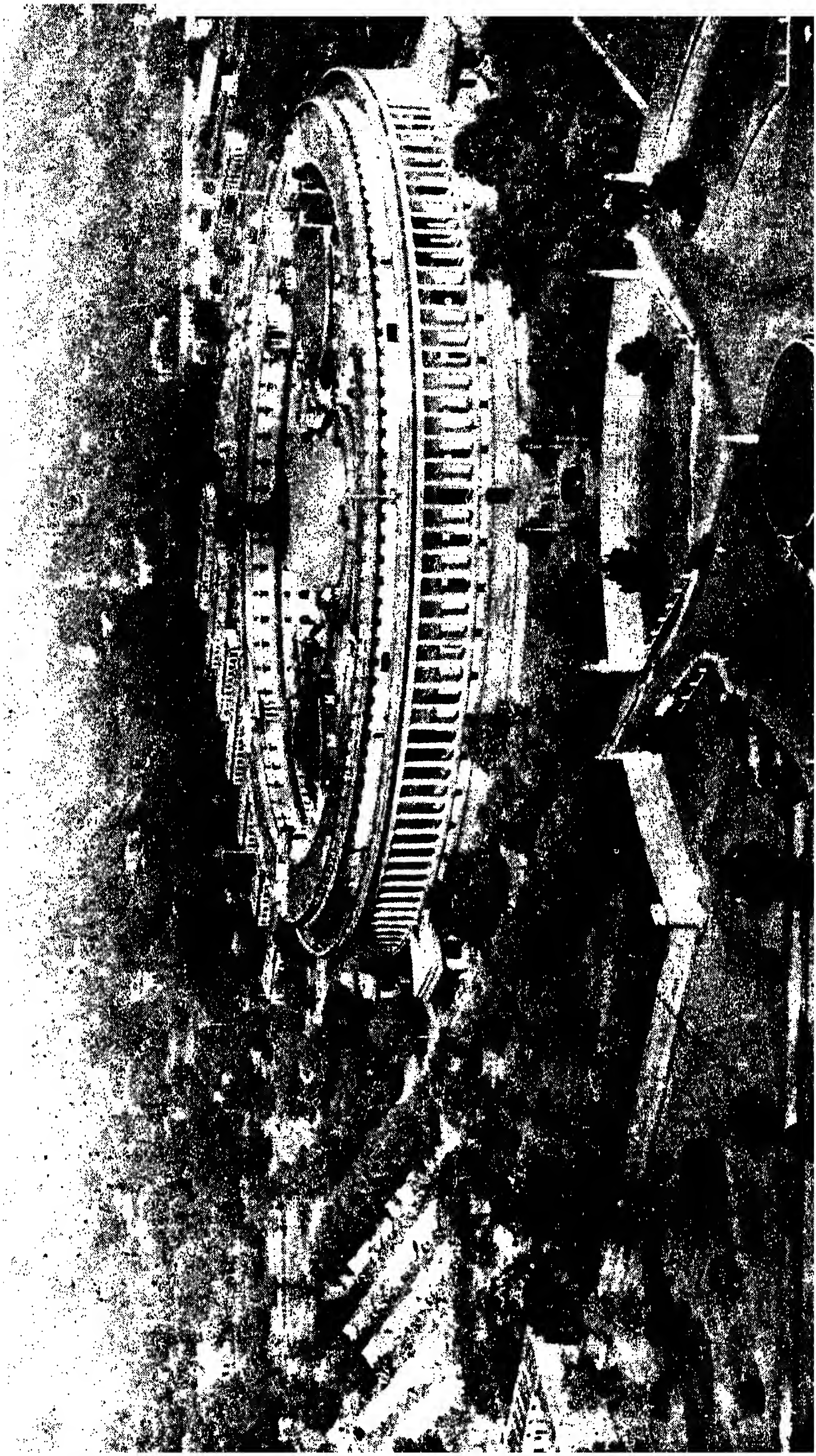
Appendix

Establishment in the Directorate of Technical Development under the Master General of the Ordnance in India.

No.	Designation of head of the Establishment.	Functions.
1.	Chief Superintendent of Development, Weapons, Jubbulpore.	Research, design, development, experiment, technical information and inspection of production of weapons.
2.	Chief Superintendent of Development, Ammunition, Kirkee.	—do—, ammunition.
3.	Chief Superintendent of Development, Instruments and Electronics, Dehra Dun.	—do—, fire control and scientific instruments, and wireless and signal stores.
4.	Inspector of Metal and Steel, Ishapore.	—do—, metals & steels.
5.	Chief Inspector of Military Explosives, Kirkee.	—do—, chemicals for offensive equipment.
6.	Chief Engineer, Development, Vehicles, Chaklala.	—do—, vehicles of all types.
7.	Chief Superintendent of Development, Stores, Cawnpore.	—do—, general stores in use in the Army.
8.	Chief Superintendent of Development, Textiles, Bombay.	—do—, cotton textiles.
9.	Chief Superintendent of Development, Clothing, Cawnpore.	—do—, military clothing.

A Panoramic View of the Council Chamber with the Secretariat in the background→





THE MALARIA INSTITUTE OF INDIA

by

Major General Sir Gordon Covell.

The Institute was founded in 1927 and was originally known as the Malaria Survey of India. The title was changed to the present designation in 1938. It was financed entirely by the Indian Research Fund Association until 1940, when the public health section was taken over by the Government of India. Its research activities continued to be financed by the Indian Research Fund Association until 1946, when the Government of India assumed responsiblity for this section also.

Southern India Branch

In 1942, advantage was taken of the generous offer of the Rockefeller Foundation to donate the equipment of its malaria research unit at Coonoor to form a much-needed Southern India Branch of the Institute. Owing to shortage of personnel during the war period, the activities of the Southern India Branch have been greatly restricted. It is hoped that the expansion of staff recently sanctioned will enable its activities to be considerably extended. Among its functions will be the provision of advice and guidance not only to the Madras and Bombay Presidencies, Coorg Province and neighbouring Indian states, but also to the numerous tea and coffee plantations and other industrial concerns located in South India.

Staff

The original cadre of officers consisted of one Director, one Assistant Director, one Entomologist and two Research Officers. Recently there has been a considerable expansion to meet the needs of the immediate post-war period and the staff now includes in addition to the Director, two Deputy Directors, six Assistant Directors, one Entomologist and one Assistant Entomologist. There has also been a corresponding expansion of the subordinate posts.

Buildings

The headquarters of the Institute were originally located at Kasauli, and the field station at Karnal, Punjab, 75 miles north of Delhi. In 1938, the field station was transferred to Delhi, the building formerly occupied by the Commander-in-Chief in India, having been acquired for that purpose. The headquarters of the Institute were transferred from Kasauli to Delhi in 1943. With the recent expansion of the staff and activities of

← The Council Chamber — The meeting place of the Constituent Assembly.

the Institute, the accommodation available in Delhi became inadequate, and a much needed new laboratory block and animal houses have recently been constructed.

The Southern India Branch is accommodated in a wing of the Pasteur Institute of Southern India, Coonoor.

Functions

1. To be fully informed upon all malaria problems. To advise Government on all issues relative to malaria in India.

2. To initiate enquiries and investigations of malaria. To carry out such enquiries as Government may for any reason require. To assist provincial organisations in the carrying out of such enquiries as may be undertaken by them, providing such assistance as desired and even in certain cases when thought necessary to lend officers temporarily from the staff to work under Local Governments.

3. To undertake systematic research in due course into all the basic facts underlying malaria transmission, prevalence and prevention, such as the study of mosquitoes, systematic and bionomical, types of malaria parasites, transmission power of different species of Anopheles, mechanism of infection including the study of endemic and epidemic phenomena, etc. Gradually to complete and organise knowledge on these subjects and to arrange for the making of such knowledge available for practical application or such other uses as may be desirable.

4. To carry out epidemiological investigations-mapping of endemicity, study of hyperendemic and healthy areas, study of malaria statistics on modern lines - and generally to elucidate the underlying principles of malaria prevalence in India.

5. To advise upon and assist in carrying out antimalaria measures. To study these scientifically and to judge of and elucidate their results.

6. To undertake clinical work on malaria, including treatment. To study serum reactions and allied aids to diagnosis and understanding of the disease. To study relapse problems, effects of new drugs, etc.

7. To assist affiliated researches (e.g., kala-azar, filariasis, sandfly fever, dengue, stegomyia work) by indentification of material, provision of trained staff and subordinate personnel.

8. To teach and train officers and others in practical malaria work.

9. To publish scientific results, useful guides, bulletins, etc.

10. To keep alive interest in malaria study and prevention and to see that such interest wherever present is nursed and assisted.

Malaria Surveys

In 1926 Covell made a re-survey of malarial conditions in the Andamans, in connection with a proposition to colonise these islands. The results of this investigation confirmed the observations made by Christophers in 1911.

In 1927 McCombie Young conducted a short survey in Coorg, and in the same year he carried out preliminary investigations in Sind in connection with the Sukhur Barrage Project. The latter enquiry was continued during the years 1928 to 1935 by Baily, working under the direction of Covell. The results of this work were published in a series of fifteen papers dealing with malarial conditions in various parts of Sind, and the effect likely to be produced by the operation of the Barrage Scheme. These prognostications were largely fulfilled during the first two years of working of the completed project, after which the inquiry was discontinued. During the course of this investigation an opportunity occurred of studying at close quarters a fulminant malaria epidemic which visited northern Sind both during the epidemic itself and also over a subsequent period of several years.

In 1926 a minor malaria epidemic had occurred in Delhi, which was investigated by Christophers. He recommended an extensive survey of malaria conditions in that city, and this was carried out during 1927-1928 by Senior White. During the succeeding years visits for advisory purposes were made to Delhi by various officers of the Institute (Sinton, Macdonald, Covell) until the commencement of the intensive antimalaria campaign which was begun in that area in 1936 (see below).

In 1928 Covell's services were loaned for six months to the Government of Bombay to carry out a malaria survey of Bombay City, which had been the subject of detailed investigations by Bentley in 1909-1910. The action taken following the report on this survey has resulted in a great diminution of malaria in that city during recent years.

In 1929 Sinton carried out surveys in a number of States in Kathiawar and Macdonald (1930) and Sinton (1933) made other visits to this area for advisory purposes. Macdonald also conducted surveys in a group of tea gardens at Mariani, Assam, in 1930, and in Bikaner State in 1931.

Covell carried out investigations in Patiala State in 1931 and 1932, and in the latter year he made a survey of malaria conditions in Calcutta

in connection with the threatened invasion of the Salt Lake area by *Anopheles sundaicus* (*ludlowi*).

In 1932 a mosquito survey was carried out in Rajputana by Jaswant Singh.

Mulligan made a preliminary survey of Quetta in 1935, immediately before the occurrence of the great earthquake, and this was followed by more extensive investigations carried out during the succeeding months.

Hicks made a mosquito survey of Karachi Airport in 1935, in connection with the possible introduction of yellow fever by air-borne traffic.

Afridi investigated malaria conditions in Kutch State in 1936-37, in Bahrein Islands, Persian Gulf, in 1938, and at Bazpur in the Terai area of the United Provinces in 1938-40. He also carried out an Aedes survey of Hog Island, Bombay, in 1938.

Surveys were carried out in the Wynaad, S. India, by Covell and Harbhagwan in 1938 39 and in the coastal belt of Orissa by Covell and Pritam Singh in 1939-42.

Jaswant Singh and Jacob carried out surveys in Ahmedabad in 1941 and in North Kanara, Bombay Presidency, in 1939-42.

Researches

(*i*) *Laboratory Researches.*

It is not possible to give more than a brief outline of the numerous researches conducted by the staff of the Institute during the past 20 years. These include a series of important investigations dealing with the treatment of malaria by Sinton and his collaborators in connection with the Quinine and Malaria Enquiry and the Malaria Treatment Centre, Kasauli, and investigations into the properties and value of a number of indigenous and synthetic drugs which has been made possible by the maintenance of strains of monkey malaria. Three different species of monkey malaria were isolated by Mulligan and Sinton, and these provided material for a series of researches on immunity in malaria, and for various biochemical and pathological investigations. They also formed the basis of a monograph by Taliaferro and Mulligan on the histopathology of malaria which appeared in the *Indian Medical Research Memoir* series.

Other subjects on which research has been conducted include a number of studies on mosquito bionomics and an extensive series of controlled experiments on insecticides and repellents under the direction of Dr. I. M. Puri.

Investigations to determine the food preferences of different species of anophelines by means of the precipitin test have also been carried out with antisera prepared at the Institute.

Systematic investigations on mosquitoes have been carried out by Barraud and Puri. Barraud's name will always be chiefly associated with his work on the culicine mosquitoes of India, of which he described a very large number of new species. This work was published in a series of articles in the *Indian Journal af Medical Research*, and was subsequently included in *The Fauna of British India, Diptera*, Volume V, of which he is the author. Puri's most outstanding work has been that dealing with the larvae of anopheline mosquitoes, which was published as a monograph in the *Indian Medical Research Memoir* series.

During his tenure as Director of the Malaria Survey, Sinton continued his systematic work on sandflies, on which he is recognised as one of the world's foremost authorities. The results of his work were published in an important series of articles which appeared in the *Indian Journal of Medical Research*.

Laboratory research work has been severely curtailed during the war period and has chiefly been directed towards the testing and development of insecticides, larvicides and repellents and to the designing of anti-mosquito equipment. The importance of these researches as a contribution to the war effort has already been mentioned.

In the laboratories at Delhi important work has been carried out in the development of stains for the diagnosis of malaria parasites. The J.S.B. watersoluble stain for the rapid diagnosis of malaria parasites evolved by Jaswant Singh and Bhattacharji has been generally accepted as a valuable contribution to laboratory technique, particularly applicable to field conditions. The same workers have more recently produced a formula which has proved an effective substitute for both Leishman and Giemsa stains. All these stains can be prepared from materials obtainable in India at moderate cost.

Laboratory strains of monkey malaria have been maintained at Delhi and have been used for testing of a number of indigenous and synthetic drugs. The determination of the source of mosquito blood meals and the preparation of anti-sera for this purpose has been continued during the war period, though on a reduced scale.

At the Southern India Branch, laboratory research activities have been directed chiefly to investigation of the bionomics of *A. fluviatilis*,

MUSEUM

STUDENTS LABORATORY

the principal vector of malaria in the foothills of South India. A strain of *P. gallinaceum* has been maintained in this laboratory.

(ii) *Field Researches*

Intensive epidemological investigations into malaria conditions have been carried out in the villages of Karnal District and Delhi Province, and also in other parts of India in connection with the numerous malaria surveys which have been undertaken by the staff from time to time.

A number of important field investigations have been carried out with D. D. T. solutions, emulsions and suspensions and also, to a more limited extent, with gammexane. A special investigatory unit known as the Insecticide and Mosquito Repellent Enquiry, operating under the Director of the Institute, has been financed by the Indian Research Fund Association for this purpose. These investigations have been carried out in South India, in the Himalayan foothills, Bengal, and more recently in Baluchistan.

During the past 12 months a number of field trials with paludrine and other synthetic antimalaria drugs have been in progress in various parts of India under the direction of the Malaria Institute of India by special arrangement with the Medical Research Council in England. These experiments have been carried out in Assam, Baluchistan, Bengal, Bihar, Bombay, Madras, and the United Provinces. Their object has been to assess the value of these drugs in the prophylaxis and treatment of malaria, particularly in villages and among labour forces employed in coalfields, plantations and other industrial concerns.

Antimalaria Operations in Delhi Urban area.

The antimalaria campaign now in progress throughout Delhi urban area, which covers 65 sq. miles of country with a population of over one million, was inaugurated in 1936 and has effected a marked reduction in the incidence of malaria. The work of controlling malaria in this area has been greatly augmented during the war period owing to the enormous increase in the population and the introduction of a large labour force engaged in carrying out an ever-expanding programme of building construction.

Malaria Organisations in other Centrally Administered areas.

These organisations, which are now in process of formation, will operate under the direction of the Malaria Institute of India.

(i) *Delhi Province.*—Three rural control units have been created, each under the immediate charge of a Malaria Assistant.

(ii) *Ajmer Merwara* and (iii) *Coorg.*—In each of these provinces there will be in the first instance a headquarter unit under a Malaria Officer with appropriate staff which will take up work in the capital and in a circle of villages immediately around it. Control units will be added in due course up to a maximum of 5 in each province, their activities being based on the headquarter unit.

(iv) *Baluchistan.* -There will be in the first instance a headquarter unit under a Malaria Officer and two malaria control units with a Malaria Assistant in charge of each.

The above schemes are intended not only to discharge the responsibilities for these areas which devolve on the Central Government, but also to demonstrate to other administrative units in India the results which can be achieved by such schemes operating under the direction of a properly established and adequately staffed organisation at the centre.

Malaria Control Organisations in Indian Coalfields.

In 1944, the Institute was called upon to undertake the task of organising malaria control measures in the coalfields throughout India, on account of the urgent necesssity of increasing the output of coal to its utmost capacity for the furtherance of the war effort. Antimalaria schemes under the direct control of the Institute are now in operation in 5 of the most important coalfields, i. e., Jharia (Bihar), Raniganj (Bengal), Pench Valley (C. P.), Margherita (Assam) and Korea State. Schemes for two other coalfields (Chanda in the C. P. and Hazaribagh in Bihar) have been sanctioned and will come into operation shortly. With the establishment of three more schemes in Rewa, Baluchistan and Assam, now under consideration, all the important coalfields in India, representing more than 95 per cent of the country's total coal output, will have been covered.

Most of these schemes have now been in operation for 2 or 3 years and they have already provided a striking demonstration of the importance of malaria control in the economic life of the country.

Preventive Measures Against Yellow Fever

In addition to its main function of dealing with problems connected with malaria, the Institute is frequently called upon to advise on measures directed against other insect borne diseases, notably yellow fever. In the course of a visit to Mid-East in 1941, Covell made a special tour through the Sudan and Kenya Colony to study and report on the anti-Aedes measures adopted in these countries in connection with seaports, ships, airfields and aircraft. In November 1944, Puri visited a number of

stations on the air route from Cairo to Khartoum to investigate the measures in force for the disinsectisation of aircraft, and he and Covell toured in Egypt, Eritrea and the Sudan in the same connection in March 1946. These two officers have made a number of other visits in recent years to Bombay, Calcutta and Karachi with a similar purpose in view. The experience gained during these tours, together with the data obtained from investigations carried out at the Institute in regard to insecticides, aerosol bombs and other spraying equipment, have formed the basis of the quarantine regulations issued from time to time by the Government of India for preventing the introduction of yellow fever into this country.

Publications

The *Journal of the Malaria Institute of India* is published quarterly under the editorship of the Director of the Institute. The articles published include not only accounts of work done by the staff of the Institute but also papers by other workers in India. Approximately 400 articles on various aspects of malaria have been published in this journal since it first appeared in 1929.

A number of *Malaria Bulletins*, forming part of the *Health Bulletin* series of the Government of India, have been produced by various members of the staff. These are published at a very low price, and there has been a great demand for them. In addition to their value in other respects, these bulletins take the place of a textbook on malaria for the use of the annual Malaria Class. By bringing out new editions at frequent intervals, it is possible to maintain the information contained in them continually up-to-date, thus doing away with one of the chief disadvantages of a comprehensive textbook.

In addition to the *Health Bulletins* and numerous articles in the *Records* and in the *Indian Journal of Medical Research*, four monographs in the *Indian Medical Research Memoir* series have been published by members of the staff, whilst a number of papers have also appeared in other scientific journals.

As was to be expected, the output of literature emanating from the Malaria Institute of India was considerably curtailed during the war period. The *Journal of the Malaria Institute of India* continued to appear, but the number of issues was reduced from four to two per year, so that each volume covered a period of two years instead of one. With the return to peace conditions, the former practice of issuing 4 numbers per annum is being resumed.

The issue of new editions of the 13 *Malaria Bulletins* included in the *Health Bulletin* series of the Government of India has been continued as in former years, and the demand for them, both in India and in other countries, is as great as ever.

Courses in Malariology

Courses in malariology for civil medical officers were held annually at the Malaria Institute of India up to the outbreak of the war. During the war period, these courses were held in abeyance, owing to the necessity for training large number of personnel for the Defence forces, but with the termination of hostilities they have been resumed.

The number of students is limited to 26, it having been found from experience that the attempt to instruct a greater number than this tends to diminish the value of the course. The students are drawn mainly from the Public Health Departments of the Provinces.

The course is an extremely comprehensive one, and students who have passed thorugh it are in a position themselves to train subordinate antimalaria personnel in practical field methods.

The course lasts for six weeks and consists of about forty lectures and 120 hours of practical instruction in the laboratory and in the field. It is designed for the training of medical officers in the basic principles and advanced aspects of malariology. The subjects taught include the identification and dissection of mosquitoes and their larvoe, the bionomics mosquitoes, the parasitology, pathology and epidemiology of malaria, modern methods of investigating and measuring the extent of malarial incidence, and the principles and practice of control measures. The class is held during the months of March and April, the candidates being selected from those applying before 31st December each year. No tuition fee is charged.

Early in the course, special areas, each containing one or more villages, are allocated to different groups of students. The latter are required to visit these areas regularly during the course, to investigate malarial conditions and mosquito prevalence in them by the methods taught and to produce a map and a report of their survey with recommendations for appropriate antimalaria measures at the end of the course. There is no set work after 1 p.m. each day, but students are expected to carry out this survey work and to practise methods of laboratory technique during the afternoon. Each student is provided with a comprehensive set of laboratory and field equipment for use during the course.

The lectures are given by the officers of the Malaria Institute of India, who are assisted in conducting the laboratory and field demonstrations by the Malaria Assistants and Laboratory Assistants on the staff. In recent years the material obtained from the study of monkey and bird malaria has been found most useful for instructional purposes.

The lectures are illustrated by a comprehensive series of diagrams and charts prepared by the staff of the Malaria Institute. These diagrams and charts, along with models of mosquitoes, antimalaria apparatus, pathologicea specimens, epidemiological graphs, photographs, etc., are placed on permanent exhibit in the museum, where they may be studied by the students at their leisure.

A practical, written and *viva voce* examination is held at the end of the course and certificates are issued to those who pass the examination. Many of the students who have passed through the course are doing valuable work in various parts of India. The conduct of the class is considered to be one of the most important functions of the Malaria Institute of India, since it turns out each year a fresh group of medical officers trained in the conduct of modern antimalaria measures.

One or more short courses for engineers, each of one week's duration, are held each year during the period July-September. Instruction is given in the basic principles of malaria prevention relating to all branches of engineering activities.

War Activities.

During the period 1939-1945 the activities of the Institute were devoted almost entirely to matters directly connected with the war effort. Chief among these were :—

1. *The training of antimalaria staff.* During the war period 21 intensive courses in malariology, each lasting for 1 month to 6 weeks, were held, at which 522 officers received training. A number of shorter courses were also held for various classes of personnel. The total number trained in antimalaria duties during this period was :—

Officers	555
I.H.C. personnel and Sanitary Inspectors	426
Engineers	87
	1,068

2. *The development of spraying equipment.*—The MISH hand sprayer for the application of insecticides was designed at the Institute and several hundreds of thousands have been supplied to the Defence Forces. A knapsack sprayer designed at the Institute was also adopted for use by the Defence Forces.

3 *The development and testing of mosquito repellents*—Many hundreds of these were tested and the repellent vanishing cream finally adopted by the Army in India was evolved at this Institute.

4. *The development and testing of insecticides and larvicides.*—A very extensive series of controlled experiments was carried out, particulary in connection with the production of a suitable DDT emulsion concentrate.

5. *The testing of indigenous and synthetic drugs* on monkey mataria.

6. *The direction of antimalaria measures* in the numerous military and RAF camps in Delhi urban area.

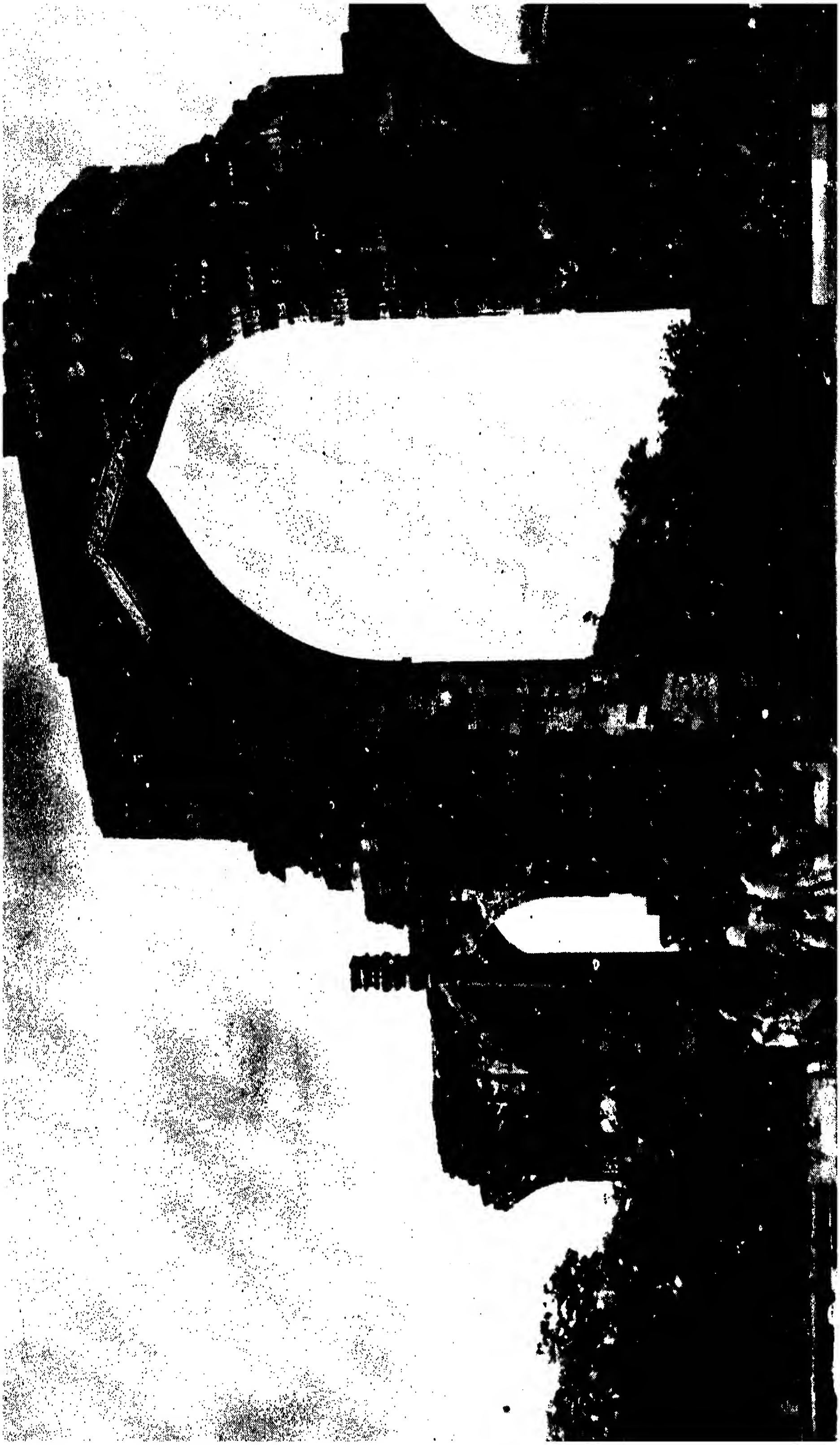
Military antimalaria organization in India and Overseas.

Prior to the outbreak of war, the Army in India possessed no regular organization for the control of malaria, either in cantonments or in the field. The first two military antimalaria units to be formed during the war period were staffed by personnel of the Malaria Institute of India and proceeded overseas early in 1940. These were the forerunners of more than 100 antimalaria units which were subsequently created. All the officers attached to these units as well as the antimalaria staff officers and the malaria officers of all cantonments in India underwent intensive courses in malariology at this Institute. The success of the Burma campaign was largely due to the remarkable results achieved by the military malaria organisation, which could not have been brought into existence without the intensive training provided by the Malaria Institute of India. Since the termination of war, one of the principal tasks of the Director and his Deputies has been to allocate the antimalaria staff now being released from military duties to fill the new posts created in the provinces and at the centre to implement the Government of India's post-war development policy.

Postwar Activities

With the termination of the war the training of personnel at the Institute for the Defence Forces has ceased and the annual malariology course for civilian medical officers has been resumed. The length of the

Oblique view of Qutab Minar and its environs



course has once more been extended to its pre-war scheme of six weeks intensive training. The short courses for engineers, held in abeyance since 1941, have also been resuscitated.

It is expected that the activities of the various provincial antimalaria organisations and those of the principal Indian States will continue to be closely linked with those of the central Institute.

In the general scheme for malaria control throughout India it is intended that the training of subordinate antimalarial personnel for the provinces shall be a function of the provincial organisations, but until these are set up and begin to function effectively, training courses will be arranged for such personnel at the centre as required.

It has been proposed that an officer of the Institute shall function as a member of the Central Waterways Irrigation and Navigation Commission, but until such an individual is appointed his duties will devolve on the Director. The Coalfields Malaria Organisation and the malaria schemes in Delhi urban and rural areas, Baluchistan, Coorg and Ajmer will remain under the direction of the Institute.

It is hoped that the Southern India Branch will now be expanded and developed, so that it may perform for Southern India the functions carried out at present for the whole country by the Malaria Institute of India.

There is urgent need for intensive investigation on a number of unsolved problems, and now that the staff of the Institute has been augmented and the necessity for training large number of personnel for the Defence Services no longer exists, the varied research activities which have suffered so much curtailment during the war years will be resumed with undiminished vigour, so that the Institute may maintain the high standard attributed to it by the Health Survey and Development Committee (1946):—

"Although the Malaria Institute has been in existence for less than twenty years, it has carried out a large volume of research work of the highest quality, and has established for itself a reputation for malaria research which is probably unequalled by any other single organisation in the world."

The great mosque of Qutb-ud-Din with the iron pillar

THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE

by

Dr. B. P. PAL

The Imperial Agricultural Research Institute was founded in 1905 at Pusa, in Bihar, with the aid of a generous benefaction by an American philanthropist, Mr. Henry Phipps. Comprising an estate of 1280 acres (later increased by the addition of about 400 acres) in a fertile tract, with extensive and well-equipped laboratories, the Institute was intended to fulfil its purpose as a centre of agricultural research and of post-graduate training in the agricultural sciences. Here a great deal of important work was done and mention should be made of the researches of Leather in soil chemistry, of Butler on fungi and on the fungal diseases of plants, of Maxwell-Lefroy in the cataloguing and combating of insect pests and of the Howards in plant breeding resulting in new strains of crop plants including the famous *Pusa wheats.* Equally famous are the pedigree herds of Sahiwal and Tharparkar cattle.

The Move to Delhi

In 1934 the disastrous earthquake which rocked North Bihar did great damage to the Institute. Two deep fissures cut the handsome main building into two, sank the foundations and seriously damaged the two wings. Faced with the question of rebuilding the Institute, the Government of India decided to transfer it to New Delhi, where by reason of its central and easily accessible location it was expected to perform more efficiently the functions for which it was established. The difficult task of shifting a whole Institute of this size with its delicate apparatus, its library and its pedigree herd was accomplished and completed by the end of October, 1936, and the new Institute was declared open on the 7th November of the same year by Lord Linlithgow after whom the Library is now named.

The Present Site

Popularly known as the "Pusa Institute" or the "New Pusa", the present Institute is situated about five miles to the west of New Delhi Railway Station, on an estate consisting of about 850 acres. Of this about 500 acres is good agricultural land, suitable for growing a large variety of crop plants. Irrigation is provided through 12,000 feet of pipe line and open channels.

Unlike the case at Pusa where the laboratories were housed in a large, central, two-storied building, at New Delhi each science has its own single-story block situated in its own compound with ample space for future

expansion. This however is not an unmixed blessing. The laboratories and bungalows are grouped around the library which forms the centre of the lay-out. The library building, which is easily distinguished by its clock-tower, possesses over 80,000 volumes and receives every important journal dealing with the agricultural sciences : it is considered to be the biggest agricultural library in the East, and perhaps in all Asia.

The Laboratories

The largest laboratory is that of that of the Division of Agricultural Chemistry and Soil Science, containing about forty rooms equipped for work in general analytical chemistry, physical chemistry, plant chemistry, microbiology, soil science, etc. There is a constant temperature room, a laboratory workshop, a pot culture house and lysimeters.

The Entomology Laboratory comprises a main laboratory, a parasite laboratory, and underground constant temperature rooms. About 10,000 species of insects are represented by the hundreds of thousands of specimens which are carefully preserved and constitute a most important collection for purposes of research and training.

Next to the Entomology Laboratory is that of the Division of Mycology and Plant Pathology. The Herbarium Room of this laboratory contains a very valuable collection of fungi. A recent addition is an insect-proof glass-house specially designed for the study of plant viruses and virus diseases.

The Botany Laboratory is situated in a 50-acre block of land laid out as an experimental area for field work in plant breeding and the allied botanical sciences. The main building contains rooms fitted up for research in plant breeding, genetics, cytology and plant physiology.

The Division of Agriculture is situated at some distance from the laboratories just mentioned and possess modern dairy buildings, a veterinary dispensary, bull runs, sheds for sick animals and for segregation, and implement and grain sheds. The newly-created Division of Agricultural Engineering is temporarily housed in the Agriculture Division.

The Research work of the Institute

Investigations in the Division of Agriculture embrace a wide variety of subjects including the building up and maintenance of soil fertility, mixed farming, the use of mechanised methods for cultural and harvesting operations, and the study of forage and fodder plants. A topic to which considerable attention has been paid in recent years is the possibility of utilising surplus water in the rivers during the months of August and September by flooding this on to land which normally cannot grow a *rabi*

crop because of insufficient moisture at sowing time; the results have been interesting and are being followed up. Another important line of investigation has been the study of the response of legumes to phosphatic manures, and the building up of soil fertility through legumes and phosphatic fertilisers.

Cattle breeding and management of cattle have always been a major activity of this Division and the fine Sahiwal and Tharparkar herds which have been built up are two of the best milch herds in the country. The Sahiwal which is located in the Institute is a great source of attraction for visitors. The Tharparkar is maintained in the Karnal Sub-station of the Institute. Attached to the Division of Agriculture are sections of Agricultural Mateorology and of Statistics. It is proposed to expand both and to develop the latter into a separate Division.

The Division of Botany maintains living crop collections for its genetic and plant breeding work. More than twenty crop plants have been handled and some of the improved strains which have been produced, notably the "Pusa" wheats, have been of considerable value to the country's agriculture. Recent work includes the artificial induction of genetic variations and cytogenetical studies; plant physiological studies have also been initiated, drought resistance in wheat being one of the subjects under study.

The Division of Mycology and Plant Pathology studies disease-causing fungi and has been actively collaborating with the Division of Botany in breeding disease-resistant strains of crop plants. The Division of Entomology is concerned with the cataloguing of insects, the study of their life-histories, and the devising of measures for the control of pests which damage agricultural crops. A good deal of work on locust control was done by this Division before work on locusts was recently transferred to the newly-organized Plant Protection Organization.

Besides collaborating with the Division of Agriculture in agronomic research and carrying out a large number of plant and soil analyses for other Divisions, the Division of Chemistry is concerned with investigations relating to problems of soil fertility, the role of trace elements, etc. In recent years a soil survey scheme with its headquarters in the Division of Chemistry has collected and collated available data on Indian soils. A soil survey section is being developed in this Division.

The newly created Division of Agricultural Engineering will be devoted to research on the improvement of agricultural machinery and implements with special reference to Indian conditions and the needs of the Indian peasants.

A Division of Economics and Agricultural Statistics will come into being shortly.

In addition to the Divisions at New Delhi, the Institute possesses a Division located at Coimbatore for sugarcane work. This station with which the names of Barber and Venkatraman are associated, has become world-famous because of the 'Co.' series of canes which have been bred there. The Institute also has permanent substations at Karnal and Pusa, and temporary ones at Simla, Kufri, Bhowali and Guntur.

Post-graduate Training

Although founded primarily as a research Institute, post-graduate training has been an important function of the Imperial Agricultural Research Institute and many scientists on the staff of Provincial and State Departments of Agriculture have been its past students. Along with research and other activities of the Institute, facilities for post-graduate training are being greatly developed.

The Institute offers 2-year post-graduate courses in Agriculture, Plant Breeding and Genetics, Sugarcane Breeding, Soil Science and Agricultural Chemistry, Mycology and Plant Pathology, and Entomology. Courses in Agricultural Engineering, Sugarcane Agronomy, Cytology and Genetics, Plant Physiology, Economics and Statistics are expected to be available within a year's time. Other courses are also being planned.

Originally a hostel with accommodation for 24 students only was provided. Now, to meet the urgent demand for post-graduate training in the agricultural sciences, a new hostel capable of accommodating 200 students is under construction.

Recent developments and the future outlook

After passing through many vicissitudes during the four decades of its existence, the Institute has recently entered an era of expansion Plans have been prepared which aim at making, more thoroughly than has been possible in the past, the Institute a main centre of fundamental research basic to Indian agriculture, where post-graduate training of the highest possible standard is also given. With this end in view additional expert staff is to be appointed, the latest equipment is to be provided and research initiated in those branches of agriculture of its underlying sciences which have not hitherto received adequate attention. The work of the Institute will thus embrace a representative cross-section of the science, industry and practice of agriculture and enable it to contribute materially to the solution of India's food, clothing, housing and industrial problems.

CENTRAL AGRICULTURAL MARKETING DEPARTMENT

by

Khan Bahadur A. R. Malik.

"The prosperity of the agriculturist and the success of any policy of general agricultural improvement depend to a very large degree on the facilities which the agricultural community has at its disposal of marketing to the best advantage such of its produce as is surplus to its own requirements.

"The agricultural departments in India have done much to improve the quality and to increase the quantity of the cultivator's outturn, but it cannot be said that they have been able to give him substantial help securing the best possible financial return for its improved quality and his increased outturn. Except to a limited extent, where improved quality is concerned, they have regarded the problems connected with marketing of his produce as outside their purview. The Co-operative Departments, again, have been too much occupied with their primary function of organising credit to be able to devote much attention to these problems nor have they been sufficiently well equipped with the special knowledge required for dealing with them. It is only in a few instances that they have been able to give the cultivator material help in disposing of his produce. His interests have, therefore, in the main, been left to the free play of economic forces and they have suffered in the process. For he is an infinitely small unit as compared with distributors and with the consumers of his produce who, in their respective fields, become every year more highly organised and more strongly consolidated. It is their interest to secure from the producer the raw material they handle or acquire at the lowest possible price. Marketing is the sole business of the distributor whereas, from the point of view of the cultivator, it is apt to be regarded as subsidiary to production. The circumstances of the average cultivator in India favour this attitude."

In these words, the Royal Commission on Agriculture stressed in their Report, published in 1928, on the problem and travails of the man who forms the backbone of the rural economy of this country. After the lapse of 18 years the words are still true. Although some progress has been made in the meantime, it cannot be said that the problems have been solved.

Good comes out of evil. A world-wide War was started by aggressor nations and when it ended, a great organisation known as FAO (Food and Agriculture Organisation) was born. In October, 1945, this body composed of all the countries of the World, laid emphasis on the problems in the following words :—

"Market is the crux of the whole food and agriculture problems. It would be useless to increase the output of food; it would be equally futile to set up optimum standards of nutrition unless some means could be found

The Church of Redemption→

to move food from the producer to the consumer at a price which represents a fair remuneration to the producer and is within the consumer's ability to pay".

In accordance with the recommendations of the Royal Commission on Agriculture, the Central Agricultural Marketing Department was established in 1935, with the threefold object of:

(1) carrying out commodity marketing surveys and publishing reports thereon,

(2) to conduct research on the fixation of quality standards for agricultural and animal husbandry produce, and

(3) to initiate development work on improved methods of marketing.

Simlutaneously, all the provinces also set up similar marketing organisations with some financial help from the Central Government. A number of Indian States also joined this scheme and appointed marketing officers of their own. Thus, by the end of 1935, a net work of marketing organisations had sprung up and started active work.

Marketing investigations and surveys

The first responsibility of the Department was, therefore, to initiate marketing surveys and to publish reports containing recommendations for improving the marketing methods and practices with regard to a number of commodities. During the 12 years of its existence, it has carried out surveys and prepared reports on 31 commodities which include practically all major agricultural and animal husbandry products. Besides these, three special reports on cold storage in Delhi Province, Co-operative Marketing in India and Fairs, Markets and Produce Exchanges have also been issued. The commodity survey reports contain not only a detailed account of existing marketing methods and conditions but also examine the price structure, the percentage of return secured by the producer out of the price ultimately paid by the consumer, describe the part played by the middlemen in the various stages of the distributive process and suggest the general lines on which the economic conditions of the producer can be improved and how an increased return can be secured for his produce. As such, these reports constitute the first large scale attempt at a detailed and scientific study of the subject with reference to each important commodity. Though they are not free from the defects common to such first attempts, they contain a mass of valuable data which could form a suitable basis for further action. In these reports repeated stress has been laid on the imperative need for the establishment of regulated markets, standardisation of weights and measures,

better storage of agricultural produce, adoption of grading and standardisation, improved packing and transport, special railway facilities, formation of producers' organisations and several other measures.

The reports have also rendered a signal service to Indian agriculture by revealing the enormous loss and wastage sustained in India on account of faulty methods of distribution and marketing. For example, owing to defective storage, there appears to be a huge annual loss of about 3 lakh tons of wheat alone valued at Rs. 2.4 crores. In the tobacco, the loss due to defective storage and damage by insects is as high as Rs. 10 lakhs per annum and the grower gets only 40 per cent. of the price realised for his stripped *Virginia* cigarette leaf sold in the United Kingdom and only about 30 or 35 per cent. of the price secured from the sun-cured varieties. Over 3 crores of rupees worth of rice is being wasted every year through weevil infestation, etc., and the Indian rice grower barely gets 8½ annas out of each rupee paid by the consumer. The egg trade suffers an annual loss of Rs. 57 lakhs a year due to staling, breakages in the course of collection, transport. distribution and other causes. Over 3 lakhs of rupees are paid as freight for carrying dirt in linseed to Calcutta market and by way of extra cleaning charges. The hide trade suffers a loss of about Rs. 70 lakhs per annum through bad flaying alone.

Standardisation and Grading

The Royal Commission drew attention to the fact that the growers in India were generally indifferent to the quality of the produce, mainly because they could never be sure of a share of the proportionate higher price of the better article. That the absence of standardisation alone acted as one of the obstacles in the way of extending India's export trade in primary products was also stressed repeatedly by the Indian Trade Commissioners abroad in their reports. The work of standardisation of agricultural products was, therefore, taken up as an important item by the Central Agricultural Marketing Department in 1936. As a preliminary step, the department arranged for the collection and analysis of a large number of market samples of different commodities. The analytical results confirmed the opinion already held regarding the poor quality of Indian agricultural produce reaching the inland and foreign markets. The department, therefore, proceeded to define standards of quality for products in clearly specified terms and to provide some means of identifying articles which were of higher grade or of better quality than others. Such characteristics of quality are usually defined in terms of purity of type, freedom from dirt and other impurities and damaged grains, etc. in the case of cereals and oilseeds

or simply in terms of size and freshness as in the case of eggs, or in terms of fair and freedom from blemish as in the case of fruits. In the case of other products such as *ghee*, *atta*, butter, edible oils and foodstuffs generally, care had to be taken to see that they were free from adulterants.

In the case of heavy staples like wheat, linseed and groundnuts, it was considered sufficient to draw up standard contracts fixing a single standard defined with reference to certain factors representing the minimum requirements of the market or as something representing the fair average quality of the class of produce concerned. In order to give an incentive to the sellers to put a better quality article on the market and to reduce the enormous wastage involved in the transport of dirt along with the produce, a mutual scale of premium and discounts for goods above or below the standard was introduced. In the case of certain other commodities, it was found more convenient and desirable to subdivide the prescribed standard into a series of grades so as to cover all or most of the stages of quality normally found in a particular class of produce. For example, it would be obviously impracticable to have only one grade for rice, the price of which ranged from Rs. 2-8-0 per maund for certain coarse hand-pounded varieties to over Rs. 20 per maund for old, fine scented rices. Such produce had, therefore, to be classified according to definite intrinsic qualities inherent in certain varieties grown in certain districts and also to prescribe standard grades within the class in respect of such factors as the percentage of broken or damaged grains in rice and corresponding factors in the case of other commodities. It was also necessary to introduce a standard method of marking such standard products so as to enable the public to indentify them easily. Care had also to be taken to ensure that such standard marks would not be used in unauthorised manner.

With this end in view, the Agricultural Produce (Grading and Marking) Act, 1937, sponsored by this Department was passed by the Central Legislature in 1937. It provided for the grading and marking of certain scheduled articles of agricultural produce by authorised packers, in accordance with the rules and specifications laid down under the Act from time to time and two penal clauses safeguarded the standard marks from counterfeiting and unauthorised use. *The Act is purely a permissive one.* It was first made applicable to fruits and vegetables, dairy produce, eggs, hides and skins, coffee and tobacco. Later on, fruit products, *ata*, cotton, rice, wheat, sannhemp, lac, oilseeds, edible oils (including hydrogenated products), *bura*, sugar, *gur* and myrobalans were included in the schedule.

With the exception of wheat, coffee, myrobalans, skins and sugar, all other commodities have been graded at one time or other in some part of India. Of these, the voluntary grading of *ghee*, edible oils, *ata*, eggs and rice became particularly popular. The grading of rice and *ata* had however to be abandoned at the close of 1944 with the worsening of the food situation when the consumer's preference for quality had to disappear in the face of acute scarcity. At present, the AGMARK grading schemes cover mainly *ghee*, edible mustard oil, certain kinds of fruits like citrus in the Punjab and Madras, eggs, sannhemp and tobacco.

Of these, the greatest measure of success has been achieved in the grading of *ghee*. This is partly explained by the fact that the extent of adulteration is also at a maximum in the *ghee* trade, and the public for whom this is a very important article of diet has naturally been attracted by a product bearing the seal of a Government Department. This scheme has also presented the greatest complexity as it was extremely difficult to arrive at and enforce a common standard for this product, the quality of which differs from province to province, in accordance with the climatic conditions and the type of cattle food. The device of a general standard capable of wide application combined with a few variations to suit selected regions has, therefore, been adopted fairly successfully. An element of compulsion has been introduced in this scheme in the United Provinces by the decision of the Provincial Government to ban the export of all but a limited quantity of AGMARK graded *ghee*. Special precautions have been taken to ensure genuineness in such *ghee* by the appointment of Government Chemists at the laboratories of authorised packers and by extreme care in the analysis of duplicate samples at the Central Control Laboratory located at Cawnpore. The question of reconciling these AGMARK standards with the different standards which exist under Provincial food laws is constantly under examination in the Marketing Department as well as in the Central Committee for Food Standards.

In the case of exported produce complusory grading is enforced with regard to the export of all varieties of sannhemp and a few specified varieties of unmanufactured tobacco. Under Section 19 of the Sea Customs Act, it has been made obligatory that all such exports should be properly graded under the Agricultural Produce (Grading and Marking) Act, 1937, and the relevant commodity rules made thereunder. The grading is done under the supervision of specially appointed Inspectorate Staff and only those consignments which bear the AGMARK label, in token of proper inspection, are allowed to go out of the country. In each case, the requirements of the importers abroad have been fully taken into consideration as

the specifications have been drawn up in consultation with the trade organisations concerned both in India and abroad. The extent of progress of these grading schemes can be judged from the fact that nearly Rs. 5½ crores worth of produce was sold under the Agmark in 1943, over Rs. 8 crores in 1944 and nearly 7½ crores in 1945.

The idea of having well defined grade and standards is, therefore, catching on and the AGMARK label is being increasingly recognised as a certificate of purity. A moderate degree of publicity has been attempted in order to drive this idea home to the consumers by means of AGMARK stalls, posters and newspaper campaigns.

Other Developmental Work

The actual task of organising developmental work towards the improvement and introduction of regulated markets, organisation of co-operative marketing societies, standardisation of weights and measures, introduction of improved containers, etc., devolves on the provinces and a good deal of preliminary work has been done by the Central and Provincial Marketing Departments in this connection. War conditions, however, interrupted these useful measures and the progress has been rather slow of late.

Future Plans

With the cessation of hostilities, the Government of India considered it necessary, in accordance with their general policy, to examine the possibilities of effective action to improve the conditions of agricultural marketing and, with this end in view, appointed a Sub-Committee of the Policy Committee on Agriculture, to examine the question in all its aspects including the regulation of markets and market charges, maintenance of standards of purity and quality, establishment of warehouses, the organisation and functions of the Central Agricultural Marketing Department and all matters incidental thereto. This Sub-Committee has recently submitted its report which contains detailed recommendations covering each aspect and particularly with regard to the future functions of the Central Agricultural Marketing Department as compared with the provincial organisations. The Committee have particularly stressed the need for energetic action to control the quality of all exports of agricultural and animal husbandry produce, by compulsion if necessary. Another recommendation of the Committee is the establishment of an all-India Marketing Board to advise the Central Government on the marketing of agricultural and animal

husbandry produce particularly with regard to—(*i*) economic investigations concerning such produce, (*ii*) research with special reference to quality characteristics of agricultural produce, (*iii*) introduction of grade standards, (*iv*) organisation and control of commodity exchanges and (*v*) the actual demonstration and suitable publicity of improved methods of marketing

The Central Agricultural Marketing Department have, therefore, in the forefront of their future plans, the question of extending quality control over the exports of a large number of agricultural and animal husbandry products such as cashewnuts, hides and skins, wool and hair, vegetable oils like mustard oil, linseed oil, and groundnut oil and other miscellaneous products like ginger and curry powder. The Department will constantly review the qualitative demand for these products in foreign countries with the help of the Indian Trade Commissioners abroad. Suitable legislation for extending the principle of compulsory grading within the country also, particularly with regard to enforcement of standard contracts in the case of heavy staples like wheat and linseed, will have to be initiated. The work of standardisation will doubtless receive further fillip with the establishment of the Indian Standards Institution, the constitution of which has been announced recently. The Agricultural Marketing Adviser participated recently in the Commonwealth Standards Conference and in the meetings of the Committee of United Nations Organisation on the subject of standards held in London in October last. It will also be necessary to have a comprehensive Market News Service giving information regarding stocks, arrivals, despatches and price of various commodities. Simultaneously, the work of preparation of different survey reports on other commodities, not so far covered, will have to be continued and the reports already published will have to be maintained up-to-date and supplemented from time to time.

The enforcement of measures designed to strengthen the bargaining power and economic position of the primary producers is essentially the responsibility of the Provincial Governments. These governments are fully conscious of these responsibilities and several of them have already formulated well designed plans for the organisation of co-operative marketing societies, the establishment and supervision of godowns for storage of produce, the establishment and running of regulated markets in an ever increasing number, the setting up of grading stations and the running of Provincial Marketing News Service. It is hoped that the Provincial and State Marketing Staffs will be augmented and enabled to play their due role in such activities with the ultimate object of improving the national economy of the country.

CENTRAL REVENUES CONTROL LABORATORY

by

Dr. S. S. AIYAR

In the years 1928 and 1929, the Government of India (Finance Department, Central Revenues) established departmental laboratories at the major Custom Houses in India and Burma to test imported articles and ensure their expeditious and just assessment. At the same time the Government decided, as an experimental measure, to have a small Central Laboratory to evolve and standardise methods of test, so as to ensure uniformity of practice at the several Customs laboratories. Accordingly, a small laboratory was started, through the courtesy of the Punjab Government at the Government College, Lahore, under Dr. H B. Dunnicliff, Professor of Chemistry who was also part-time Special Chemical Adviser to the Central Board of Revenue. The usefulness and importance of this, were soon manifest, and the Government decided to establish a larger and permanent laboratory at Delhi under a full-time officer. Owing, however to the severe financial depression of the early thirties, this decision could be given practical effect to only in 1939. As the original laboratory was found to be insufficient in space, it was extended in 1943.

In view of certain facilities available in the area, the Central Revenues Control Laboratory was built in the grounds of the Agricultural Research Institute, New Delhi. It came into being in November 1939 with Dr. H. B. Dunnicliff C.I.E. as its first Chief Chemist. Since April 1943, it is under Dr. S. S. Aiyar, the present Chief Chemist. In addition to the Chief Chemist, it has on its staff three chemists (Chemical Examiners of gazetted rank) and six assistant chemists. There is also a very useful library of selected books and journals to which further additions are gradually made.

Its scope is much wider than what was envisaged at the inception of the small Lahore laboratory. Its work embraces all the chemical aspects of Customs and Central Excise administration and questions connected with the manufacture of opium and opium alkaloids at the Government Factory, Ghazipur.

Though it is not a research institution in the accepted sense of the phrase, it is called upon to investigate numerous problems from the fiscal point of view and the work is necessarily confidential.

The head of this laboratory (Chief Chemist, Central Revenues) has supervision in technical matters over all the other laboratories subordinate

to the Central Board of Revenue. Further, though it is a department of the Central Board of Revenue mainly concerned with the Central Board of Revenue's work, its laboratory facilities and the technical knowledge of the staff are made use of to a certain extent by other sister departments of the Government of India, e.g., Commerce, Explosives, Food, etc., and also by some provincial Governments and Indian States.

The Chief Chemist is a member of the Spirituous Liquors Alcoholic Beverages Committee of the Technical Panel, Food Department, Government of India. Following a resolution of the Committee, the investigation on the quality of the Indian made spirits and evolving standards of quality for such products manufactured in India has been taken up by the Central Revenues Control Laboratory. The scheme has been sanctioned by the Food Department for study with the approval of the Finance Department.

The range of products tested is very extensive embracing spirituous products, textiles, paper, paints and varnishes, salt, sugar, molasses, confectionary goods, petroleum, dangerous drugs, oils, ghee, tobacco, motor spirit, and vegetable products, miscellaneous factory products, proprietary preparations, medicines and drugs, and products of undisclosed composition.

The following brief list gives an idea of the nature of the work tested out here.

(i) Check test of samples analysed by the chemists at other laboratories subordinate to the Board.

(ii) Appellate tests in cases where the report of a subordinate laboratory is questioned by any party.

(iii) Coordination of tested results and issue of a standard list of tested products, which is circulated to various Customs officers.

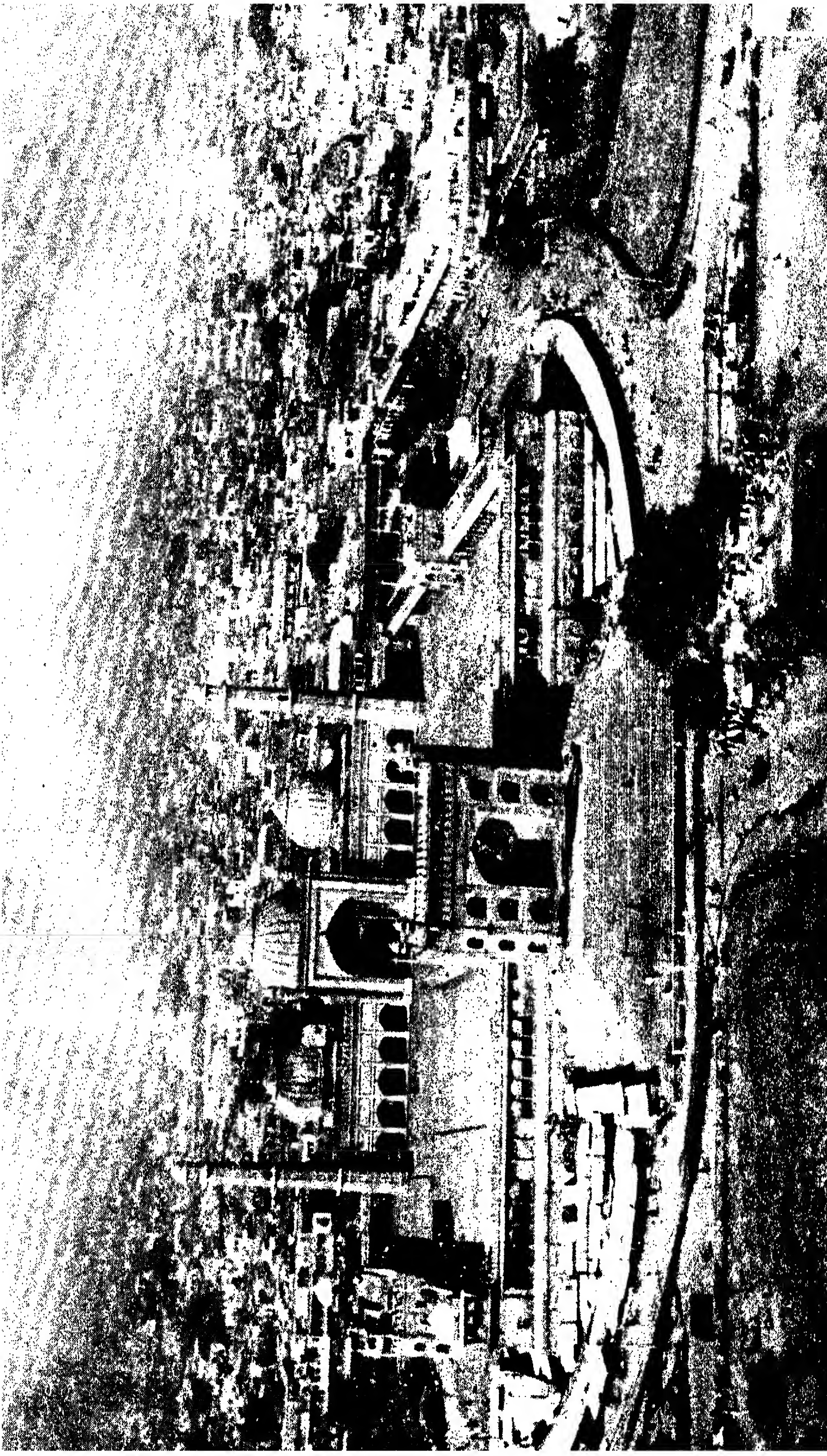
(iv) Tests on behalf of certain provincial Governments, Centrally Administered areas, and some States (mainly liquors and dangerous drugs).

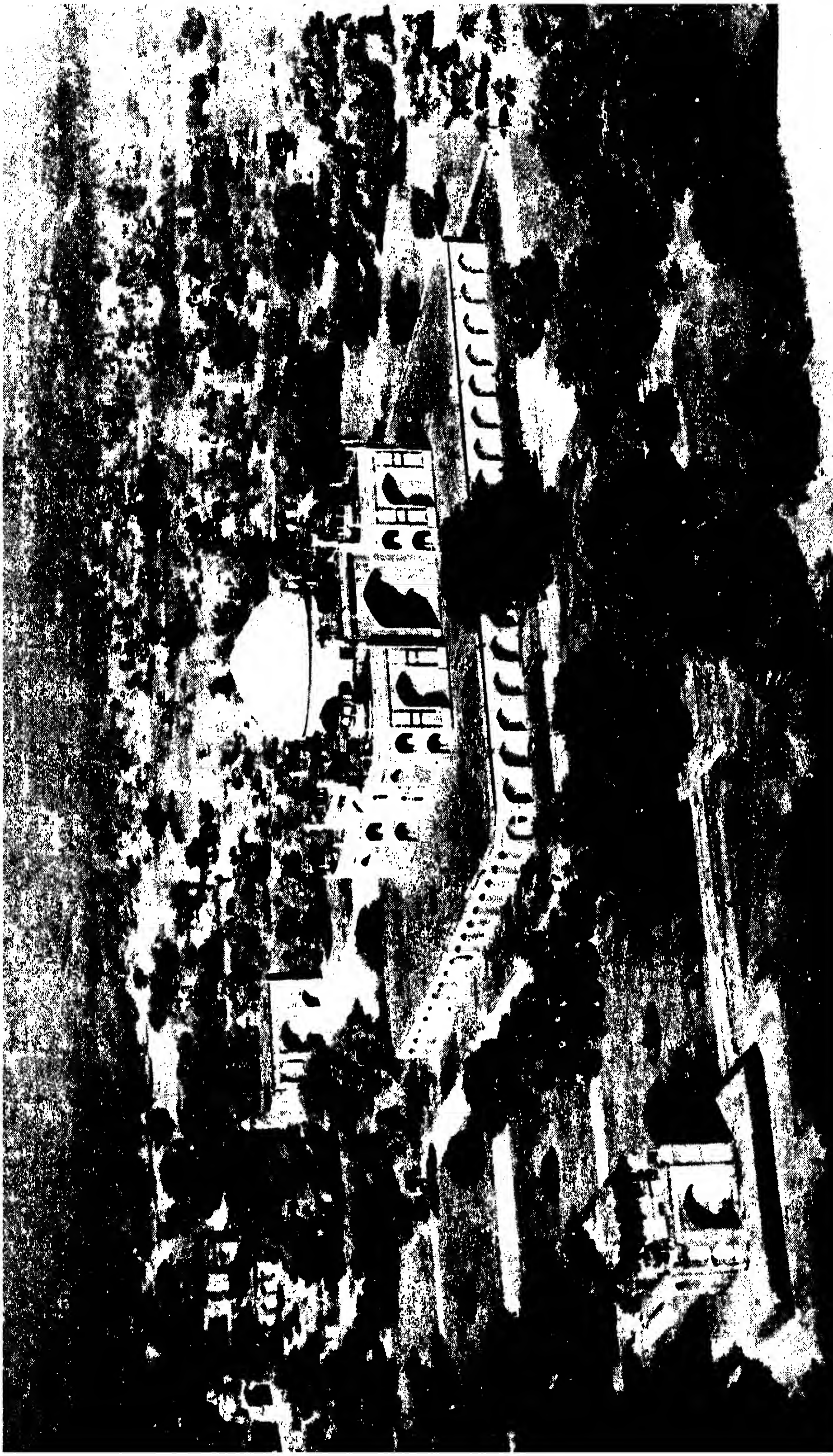
(v) Reconditioning of Sikes's metal hydrometers and standardisation of Sikes's hydrometers, both metal and glass.

(vi) Investigation of analytical processes with a view to adapting them for rapid routine work and uniformity at all ports.

(vii) Advice on technical matters, staff to the Central Board of Revenue, and the Customs and Central Excise authorities (Collectors).

Jumma Masjid—with a panoramic view of Delhi in the background. →





(viii) Investigation of problems connected with Customs, Central Excise (Sugar, tobacco, etc.) and opium work.

(ix) Manufacture of cocaine hydrochloride *B. P.* from contraband seizures of cocaine, the latter being generally highly adulterated.

(x) Testing under certain Acts for other Departments of Government of India, e.g. petroleum, explosives food-stuffs, for ships crews (Port Health Department).

(xi) Testing under Control regulations, e.g., paper control.

Item No. (ix) mentioned above is interesting. Formerly most of the contraband cocaine was destroyed being unfit for medicinal use. Since the work of purification was authorised by the Central Board of Revenue, several pounds of cocaine hydrochloride *B. P.* have been produced and supplied to the Government medical authorities.

During the recent war, this laboratory was authorised to manufacture synthetic codeine from crude morphine supplied by the Government Opium Factory. About 900 lbs. of codeine phosphate *B.P.* (from synthetic codeine) was made during the years 1942-45 and supplied to the Defence Services at a time when other usual channels of supply were cut off.

The recent discovery and exploitation of the sodium sulphate deposits at Didwana are the direct outcome of investigations carried out in this laboratory.

The Chief Chemist and the staff of the Control Laboratory have also contributed monographs on (a) Bixa orellana, (b) Musk and (c) Menthol, to the proposed Dictionary of Economic products and Industrial Resources of India under the Council of Scientific and Industrial Research.

The Chief Chemist is an *ex-officio* member of the Drugs Technical Advisory Board and is also a member of several other committees constituted by other Departments. Naturally some of the technical problems arising out of them are studied in this laboratory but in most cases, they are not intended for publication. However a number of scientific papers and research memoirs have been published in Indian and foreign Journals, which are of general scientific interest.

← Oblique view of the Humayun's Tomb

NATIONAL INSTITUTE OF SCIENCES OF INDIA

The National Institute of Sciences of India was founded in 1934 with the following objects :-

(a) The promotion of natural knowledge in India including its practical application to problems of national welfare.

(b) To effect co-ordination between scientific academies, societies, institutions and Government Scientific Departments and services.

(c) To act as a body of scientists of eminence for the promotion and safeguarding of the interests of scientists in India and to represent internationally the scientific work of India.

(d) To act through properly constituted National Committees in which other learned academies and societies will be associated, as the National Research Council of India, for undertaking such scientific work of national and international importance as the Council may be called upon to perform by the public and by Government.

(e) To publish such proceedings, journals, memoirs and transactions, and other publications as may be found desirable.

(f) To promote and maintain liaison between Science and letters.

(g) To secure and manage funds and endowments for the promotion of Science.

(h) To do and perform all other acts, matters, and things that may assist in, conduce to, or be necessary for the fulfilment of the above mentioned aims and objects of the Institute.

Membership

The membership consists of 232 Ordinary Fellows of whom 125 are Foundation Fellows, and 25 Honorary Fellows. Persons of all nations are eligible for Fellowship of the Institute.

The Governing body of the Institute is the Council which consists of 8 Office-Bearers and 17 members. The Office-Bearers for the year 1946 are :

Prof. D. N. Wadia.	—	President.
Prof Sir S. S. Bhatnagar and Prof H. J. Bhabha	—	Vice-Presidents
Dr. Bashir Ahmad	—	Treasurer
Sir J. C. Ghosh	—	Foreign Secretary.
Dr. S. L. Hora and Dr. D. S. Kothari	—	Secretaries
Prof. J. N. Mukherji	—	Editor of Publications.

Programme of Work.

The Institute's activities are of an all India character, and a scheme of co-operation with the four following Academics of Science in India has been devised : –

Royal Asiatic Society of Bengal ;
National Academy of Sciences, India ;
Indian Science Congress Association ;
Indian Academy of Sciences

This scheme provides for the representation of these academics on the Council of the National Institute of Sciences of India in the form of an additional Vice-President and an additional member of the Council for each such academy.

The object (f) of the Institute "To promote and maintain a liaison between science and Letters" has so far been kept in abeyance. In encouraging and co-ordinating scientific research, however, the Institute has done much valuable work, and has now been formally recognised by the Government of India as the premier scientific organization of the country, to whom questions regarding financial aid to scientific academies and institutions engaged in research will be referred by the Government for consultation and advice.

So far the Institute had its main office in Calcutta and a smaller one in Delhi, but with effect from 1947 an expanded main office will be located in Delhi. The Calcutta office, will however, continue to deal with the work of publication.

The Programme of work of the Institute consists of (1) reading and publication of original papers and lectures at general meetings, (2) granting of Research Fellowships to highly qualified young scientists who are expected to devote all their time to Research under eminent scientists, (3) arranging of lectures and symposiums on scientific subjects of general, economic, industrial or special interest, (4) publication of original contributions, scientific researches and Proceedings and Transactions, and aiding similar publications of other scientific academies and institutions in India.

During the year under report the Institute was invited by Pandit Jawaharlal Nehru, President of the National Planning Committee, to send a representative on the Committee and the President, Prof. D. N. Wadia, was selected for the purpose, with power to nominate another Fellow of the Institute as a substitute whenever he could not attend any particular meeting himself.

The programme of work of the Institute is not confined to India. It is well known abroad and its publications are in demand by scientific

societies in Europe and America. The Institute was invited this year by the President of the Royal Society to send four representatives to "Newton's Commemorative Celebrations, and the following delegation was appointed :-

Prof. D. N. Wadia, President (Leader).
Prof. H. J. Bhabha.
Prof. K. S. Krishnan.
Prof. M. N. Saha.

In response to invitations from the National Academy of Sciences and the American Philosophical Society of Philadelphia, the Institute deputed Prof. H. J. Bhabha, Sir K. S. Krishnan, Prof. P. C. Mahalanobis and Col. Sir S. S. Sokhey to take part in the Autumn meetings of these societies.

GRANTS

The Institute received the following grants in the year 1946-47 :-

(i) *Government Grants* :–

Non-Recurring : for a new Institute Building, Rs. 2,20,000.
Recurring : for secretariat expenses, Research Fellowships, Library, publications and travelling Expenses, Rs. 1,02,000.

(ii) *Imperial Chemical Industries Grant* : for awarding Fellowships, Rs. 40,000.

(iii) *Rockefeller Foundation grant* : for aid to Scientific Publications of Indian Societies and Academies Rs. 15,000.

National Institute Research Fellowships

The Institute awarded six Senior Research Fellowships to highly qualified young scientists (age about 35). Each senior Fellowship carries Rs. 500/- a month. Five Junior Research Fellowships carrying Rs. 350/- a month were awarded to younger men of high qualifications. These Fellowships are ordinarily tenable for two years, but the period may be extended to three years in special cases.

Imperial Chemical Industries Research Fellowships

Four Fellowships of the value of Rs 400 per month are awarded every year.

Aid to Publications

Besides Rs. 15,000 from the Rockefeller Foundation the Institute gave Rs. 15,000 from its own funds, and the total amount of Rs. 30,000 was distributed by the Institute to various scientific societies in India in aid of their publications No part of this amount was used on the Institute's own publications.

THE JAMIA MILLIA ISLAMIA

An educational institution should not need to justify itself if it can bring together students wishing to learn and teachers able to teach according to an average standard of efficiency and success. But during the twenty-five years of its existence, the Jamia Millia has had continuously to explain why it came into being and why it desired to keep alive. These questions have seldom been asked to elicit from the people of the Jamia Millia their views about education and how it should be organised. On the contrary, the implication has always been that educational institutions should conform to the established type, because in that way alone could they offer the advantages and raise the funds that would maintain them. And not only outsiders mildly surprised that so many men who might have been quite well-off and useful otherwise should have chosen to waste their lives in worries and difficulties asked these questions, the teachers of the Jamia Millia themselves have, in moments of despondency and distress, asked each other what they were doing and why. These questions have always been irritating, but having had to answer them for twenty-five years we feel that they have helped to explain a number of things to others and to ourselves as well.

The child going to school wonders why it is made to learn things, and though it wants to live, it does not know what it is living for and what it will become. In 1920 some teachers and students formed themselves into an educational body because they were told, and themselves believed, that a freer, fuller education, called 'national' education for want of a clearer term, was necessary. They also hoped that the political movement which demanded national education and advocated boycott of schools would succeed, and all universities, colleges and schools would become national. That did not happen. The non-cooperation movement was suspended, and there was bitterness and disillusionment. But the Jamia Millia staff and students refused to cut their losses to return to normal. They felt they had something to live for; their work must go on. But their objectives were not clear to them. There was too much strife between Hindus and Muslims for the term 'national' to have any appeal or meaning, except to the incorrigible few. Some who were among the founders of the Jamia Millia declared that it had outlived its use and should close down. Others, equally among the founders, believed that it was only now becoming useful.

Some of the staff quietly found other work, many of the students joined other schools and colleges, but enough remained to carry on the work. The Jamia Millia was transfered from Aligarh, where it had been originally established, to Delhi and here it emerged in its real character. This was in 1925, when the Jamia Millia was five years old.

What was the Jamia Millia then ? A body of teachers and students, with the late Hakim Ajmal Khan as guardian angel. He was a guardian because he undertook to find the money for its expenses, an angel because he did not interefere in its day to day work, helped in every way possible and asked for no homage in return. Dr. Zakir Husain took charge as Sheikhul-Jamia or chief executive and academic officer immediately after his return from Germany in March 1926. In December next year Hakim Ajmal Khan, who was already too weak for the enormous burden which he had taken upon himself, died and the Jamia Millia was reduced to what it should have been and has remained since, a body of teachers and students responsible only to God and their conscience.

The teachers, of course, constitute the more permanent element. In 1928 they formed themselves into a Society for National Education, with a membership pledge of twenty years' service on a salary not exceeding 150/- a month. This Society recognised no outside authority and resolved to accept no aid to which conditions limiting its supreme authority were attached. Eleven years later the Society registered itself as the Jamia Millia Islamia Society and drafted a constitution which still operates. It has now in its charge two primary schools, a village school, a secondary school, a college, a teachers' training institute, a public library, an adult education department, a hall or community centre and publishing house. There is a separate department for educational publicity and the collection of funds. A dairy and a farm are now in the making. This building up of an educational colony at Okhla, seven miles outside Delhi, has been projected through the addition of a polytechnic, a girls' college, a hospital and other institutions.

But with all this we are still answering the first, fundamental question. Why should there be a Jamia Millia, when it can never hope to be more than a group of small institutions in a country where everything must be done on a large scale to achieve appreciable results ? The question does not irritate us now, because it is asked in a different spirit, and because we can answer it with a little more wisdom and confidence. It has been a natural result of our growth that we understand ourselves better and see our future somewhat more clearly. Of course we are not sure even now

where our realities end and our dreams begin, and we may discover unexpected possibilities or limitations in ourselves and our work. But there are things we can say about ourselves with some degree of certainty.

The Jamia Millia is an experiment. Like all experiments, it might have shown results and it might have failed, but we felt that if a group of men who believed a certain type of education was necessary elected to devote their lives and energies to it, and called it just an experiment, it would serve to warn or encourage other and better men and would not be much of a loss to a country suffering from a superfluity of inhabitants.

The Jamia Millia is an experiment in another and more important sense. Can a group of teachers willing to devote themselves to their work carry on without assistance from government or men of wealth and influence ? It is generally believed that they cannot, and grants-in-aid which bring with them the atmosphere and mentality of a government department, or donations which make schools or colleges the backyards of rich men's houses or cockpits of petty politicians are considered indispensable. The Jamia Millia has no resources of its own and has lived from hand to mouth. It has had to raise funds continuously from year to year to meet its expenses, but has nevertheless maintained its independence in theory and in fact. Its teachers have worked as free agents and have not gloomily confined their attention to prescribed work. They have desired freedom and have joyfully paid the price. This would certainly have been far heavier than it was but for Dr. Zakir Husain's personality, which soon earned widespread recognition as the embodiment of the ideals of the Jamia Millia, but Dr. Zakir Husain's task has been considerably lightened by another aspect of the Jamia Millia experiment.

It would be too much of a digression to discuss the philosophy of education here. It is enough for the moment if it is admitted that most educationists are agreed that true education can only be imparted through the medium of the traditional culture and the social environment of the educand. The Jamia Millia was intuitively groping for this principle when it called itself 'national'. It grasped it quite firmly by resolving that the mother-tongue of the students should be the medium of instruction. And Gandhiji helped it to realise and assert its real nature when he insisted on more than one critical occasion that the Jamia Millia should be a distinctively Muslim institution in spirit as well as in name. He has had his reward. The Jamia Millia is one of the few institutions where the cultural character of others has been respected and communalism has been abhor-

red, where reasonableness, tolerance and cheerful friendliness have become so obvious and natural elements of behaviour that exclusive and unsocial sentiments evoke immediate and hostile reaction. Many people are surprised and perhaps disappointed that the Jamia Millia has a political creed but no party affiliations, but the consistency with which the Jamia has adhered to its policy has silenced many objections. Muslims have on the whole accepted the Jamia Millia as representative of their culture and traditions, and the help they have given has forged links so strong that the Jamia Millia can claim to have realised its ideal of the relationship between the school and the community, between education and the cultural character of the people. And the society which it aspires to serve has recognised, and by degress learnt to value, all the three aspects of the Jamia Millia experiment. It recognises the right of educators to experiment, it honours their claim to independence and it has felt proud and grateful to find that its traditions and cultural goods form the medium and inspiration of the education imparted by the Jamia Millia.

So much for the experiment in principles. The Jamia Millia could not have achieved anything itself or prepared the ground for a better system of education if it just took over the methods of the book school. Happily, it was debarred from following current methods because its degrees were not recognised. It had to strike out new paths to justify itself and derive advantage from the freedom which it enjoyed to devise its own system and frame its own curriculum, in other words, to experiment in methods as it had done in principles. This need to build up a system that was different,—and necessarily better, the book school being what it is ,called into play all the initiative the teachers of the Jamia Millia possessed, and nothing was too bold or unorthodox for them if they could learn enough about it to make a start. Another factor was the students. The Jamia Millia, as an unrecognised and poor institution, could not attract large numbers of students, and could not adopt the take-it-or-leave-it attitude of schools which deal in masses. Every student in the Jamia Millia had his value. Rich or poor, intelligent or dull, he was precious human material. The close association of teachers and pupils, the personal contact between parents and teachers placed the institutions of the Jamia Millia on an entirely new footing. There was an atmosphere of freedom, a touch of the familiarities of family life, a profound feeling of equality; everything almost, except the funds, for essaying new methods.

For the psychologist, if not for the expert in technique, the relationship between pupil, teacher and school is an important if not fundamental consideration in method. Sound education is possible, perhaps, where the teacher is competent and conscientious, but also remote and impersonal. But this is a method which the Jamia Millia could not attempt. It could not provide teachers efficient enough, and further could not because of its circumstances, allow its efficient teachers to concentrate on mechanical perfection in methods of instruction. The objection of a very sympathetic English critic that the Jamia Millia people are not precise is not without foundation. The relationship between pupil and teacher and between both and the Jamia Millia is on a natural rather than logical or mechanical basis. Methods have been introduced by some teachers which others did not understand or agree with, and projects have been undertaken which helped to educate through building up a corporate and co-operative spirit but were not directly based on the carriculum. The fact that the Jamia Millia has a life of its own has always exercised a decisive influence on the details of the work in the different institutions. It cannot be said that the Jamia Millia works along one given system; we can only say that it represents a community of life based on work.

Those who know Dr. Zakir Husain as the founder of the scheme of basic national education expect to see in the Jamia Millia all the characteristics of the new village school. But the scheme is meant to serve one purpose, the Jamia Millia another. We have, indeed, a Teachers' Training Institute and a village school, but the Jamia Millia primary schools are work-centered rather than craft-centered. Crafts are taught, and in the day-school most of the teaching is integrated round the craft, but those who look for detailed, mechanical coordination may be disappointed to find some links missing. In fact the coordination is there, not in its orthodox or obvious form. Religious instruction, for instance, though not related to any particular craft, is a coordination demanded by the social environment of the children. English is taught as a second language from the fourth primary grade,—an instance of our having to yeild to the opinion of parents,—but it is coordinated with other subjects through various permanent projects. These permanent projects, whose number is continually growing, and other occasional projects, some undertaken by particular classes and others by the whole school, form the dominant feature so far as our methods of primary education are concerned. A Children's Bank, a Children's Stationery Shop, a Tea shop, the Prophets' Birthday, the National Week, the Foundation Day, these are the more

important permanent projects. Poultry-farming and health are permanent projects of one class, nature-study of another. Spinning, gardening, card-board work and clay modelling are activities which serve partly as crafts and partly as hobbies, but they are integrated with the syllabus and are not just an addition to it. Self-government is another activity which is very educative, even if difficult to classify. The boys have a school association with a vice-president, secretary, treasurer, captain, librarian and executive committee. The association holds meetings for discussion and lectures, and publishes a weekly wall-paper. Apart from this, each hostel has its own association with its office bearers who are responsible for cleanliness and proper organisation of hostel life. There is, besides, a school *panchayat* to deal with delinquencies, and monitors in charge of service in the dining-hall. A thorough, scientific adoption of any one system may have been more satisfying to logical minds, and it may be possible for us in course of time to say that we have given up eclecticism in favour of a perfected orthodoxy, but even now we can make a not unjust claim to have developed a scheme in which different methods are harmonised within the framework of purposeful, educative activity.

The secondary school and the college have felt far more than the primary school the lack of equipment and opportunity. In the secondary school the individual method of work is being introduced by degrees, but lack of literature has proved a great drawback. The teaching of science is integrated around productive activity and the mosquito repellents, tooth-powder, ink, jam and fruit squashes of the Jamia Chemical Industries, as this enterprise is called, are great favourites with those who know them But this department lacks a proper laboratory and facilities for production, and shortage of indispensable material has further reduced the scale of its work during the last six years. In the college coordinated arts course is offered, with Urdu as the medium of instruction and English as a compulsory second language. The college has been too small an institution for the question of employment to have become a problem, but those of our students who do not come from families engaged in trade and industry easily find work as journalists, teachers and employees of private concerns They suffer from many handicaps, but they do not feel that they were born for employment in which they had no moral or social concern. They have free minds and generally able bodies and less of selfishness and indifferences than the average educated young man.

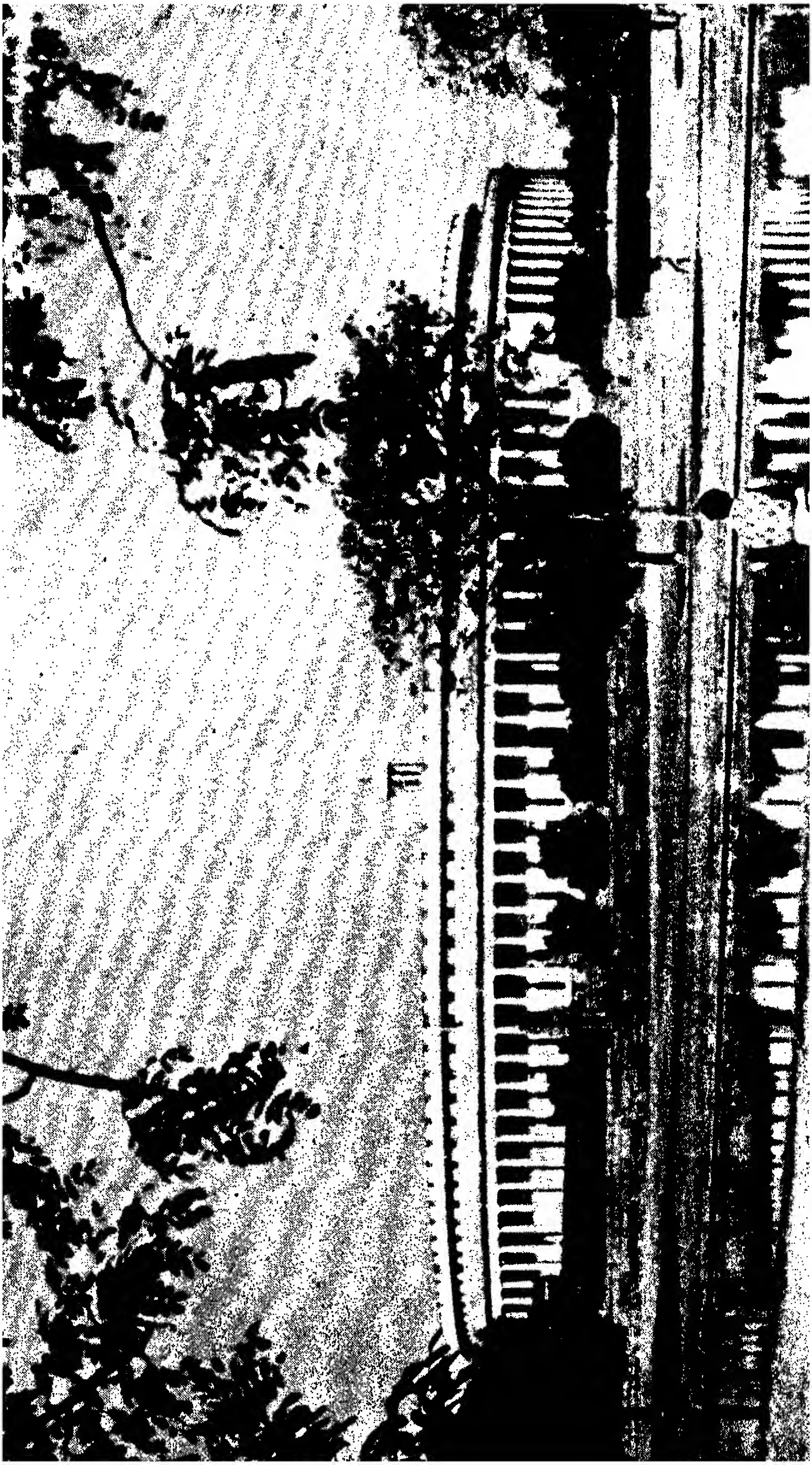
Being essentially an experiment, the Jamia Millia has not confined its activities to any one field of work. It was not enough for it to have

schools and a college. It has had, almost from the beginning, a publication department for educational and general literature, which for the last few years has concentrated chiefly on books for children, which were sadly lacking. Through the Urdu Academy, which selects publications and keeps in touch with the reading public, the Jamia Millia has helped to stimulate a taste for knowledge and literature. A department for adult education was established in 1938. This has worked on an experimental scale, but it has by now evolved methods and prepared material which will reduce the task of any government interested in the liquidation of adult illiteracy to pure multiplication of the type of centre our department has established and the literature and other material which it has prepared. The literature is already in great demand.

A recent development has been the establishment of a Hall or Community Centre by this department at Karol Bagh. Very few wards or population units in our cities provide facilities for people to come together during leisure hours. The Hall has a nominal membership fee and is open to men of all communities and professions. It provides newspapers, a radio, sports, indoor games, arranges lectures on subjects in which the members are interested and encourages them to divice means of amusing and instructing themselves. Already the Hall has a large membership and men of all communities gather together in an atmosphere of friendliness and mutul consideration. For the boys of all communities separate arrangements are made. They collect in large numbers in a neighbouring park every afternoon and play football and other games, with a kind of social evening at the end. This keeps them busy and helps them to develop friendships in an atmosphere where everything else seems to divide and embitter.

The Jamia Millia has attempted to serve its people in every way within its means for twenty five years and placed its record for scrutiny and constructive criticism at the Silver Jubilee celebrated in November last. It invited its supporters and sympathisers to help in its projects for expansion, and give their blessings to new enterprises in a future which, to many who deny themselves the right to creative work and to the joy of life, appeared to be filled with fear and despair.

The Council Chamber, →
New Delhi.



DELHI

SOUVENIR PUBLICATION OF THE
INDIAN SCIENCE CONGRESS, 1947

ADVERTISEMENT SECTION

D. D. T.

Product:	Strength:	Price per lb.
D D T. Technical		Rs 5/8
D. D. T. in Kerosene	5%	1 8
D. D. T. Hair Lotion--2 oz Packing		1 8
D. D. T Hair Lotion- 4 oz. Packing		2 8

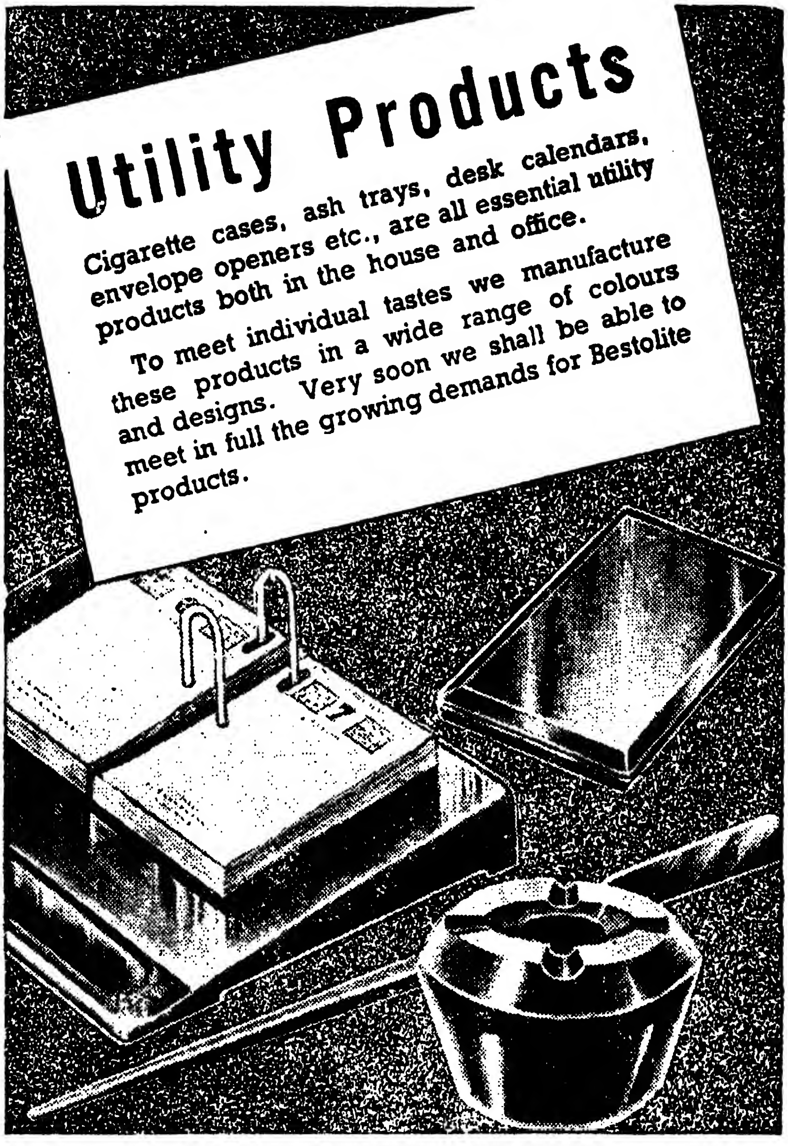
Quotations for bulk packings would be submitted on request.

We also supply Reagents and Instructions for the Micro Estimation of D. D. T. in Spray Residues such as scrapings from walls, washings from Cloth, Fruits, Grains, etc.

Estimations can be made up to 10 microgrammes in a sample.

BIRLA LABORATORIES

Sales Office : 64, Pathuriaghat Street, Calcutta



BESTOLITE

PRODUCTS OF

INDIAN PLASTICS LIMITED

BANK STREET, FORT, BOMBAY

EYE OINTMENT PRICE LIST

REDUCED PRICES

	Packings	
	1 oz. R.A.	100 grs. R.A.
1. Anti Cataractous	3 0	1 4
2. Anti Leucoma	2 8	1 4
3. Anti Conjunctivitis	2 8	1 4
4. Anti Keratitis & Pannus	3 0	1 6
5. Anti Keratomalacia	4 0	2 0
6. Anti Corneal Ulcer	2 8	1 4
7. Anti Bacterial	2 8	1 4
8. Anti Chalazion	3 0	1 8
9. Anti Iridocyclitis	3 0	1 8
10. Anti Scleritis	2 8	1 4
11. Anti Blepharitis	2 8	1 4
12. Sulphanilamide Cum Atropine	2 8	1 4
13. Sulphanilamide Cum Dionine	2 8	1 4
14. Sulphanilamide Cum Copper	2 8	1 4
15. Sulphanilamide Cum Zinc	2 8	1 4
16. Sulphanilamide Cum Yellow Oxide of Mercury	2 8	1 4
17 Anti Pneumococcal	2 8	1 4
18. Anti Gonococcal	2 8	1 4
19. Copper Citrate Cum Atropine	2 8	1 4
20. Yellow Oxide of Mercury	2 8	1 4
21. Halibut-Liver oil Cum Yellow Oxide of Mercury	3 0	1 8
22. Halibut-liver oil Cum Plasma Cum Atropine	3 0	1 8
23. Dionine	2 8	1 8
24. Atropine and Dionine	2 8	1 4
25. Argyrol	2 8	1 4
26. Atropine	2 8	1 4
27. Anti Septic Sedative	2 8	1 4
28. Argento Cuprum	2 8	1 4
29. Bichloride Mercury	2 8	1 4
30. Bismuth Iodoform Paste	3 0	1 8
31. Boric Acid Ointment	2 8	1 4
32. Boric and Zinc	2 8	1 4
33. Calomel Ointment	2 8	1 4
34. Chaulmoogra Oil	2 8	1 4
35. Collargol	2 8	1 4
36. Copper Citrate	2 8	1 4
37. Eserine Ointment	4 0	1 8
38 Homatrophine	2 8	1 4
39. Mercurochrome and Atropine	2 8	1 4
40. Procain & Chloretone	3 0	1 8
41 Pilocarpine	2 8	1 6
42. Protargal	2 8	1 4
43. Picric	2 8	1 4
44. Scarlet Red Ointment	2 8	1 4
45. Thiosinamine Mixed	4 8	1 8
46. White Precipitate	2 8	1 4
47 Xeroform	2 8	1 4
48. Zinc Ointment	2 8	1 4
49. Zinc and Itchyol	2 8	1 4
50. Picric Cum Atropine	2 8	1 4
51. Pilocarpine Cum Dionine	3 0	1 8
52 Xeroform Cum Atropine	2 8	1 4
53. Quinine Bisulphate	2 8	1 4
54. Yellow oxide of Mercury Cum Balsam Peru	2 8	1 4
55 Scopalamine	3 0	1 8
56. Anti Pyogenous	2 8	1 4
57. Sulphanilamide Cum Chaulmoogra Oil	2 8	1 4
58. Sulphanilamide Cum Shark-Liver Oil	2 8	1 4
59. Yellow Oxide of Mercury Cum Atropine	2 8	1 4
60. Sulphadiazine	3 0	1 8
61. Sulphadiazine Cum Atropine	3 0	1 8
62. Penicillin Strong		2 8
63. Penicillin Cum Atropine	4 8	1 8
64. Penicillin Cum Sulphathiozole	4 8	1 8
65. Copper Cum Protargol	2 8	1 8
66. Penicillin Cum Sulphadiazine	4 8	1 8
67. Penicillin Cum Sulphanilamide	4 8	1 8
68. Calomel Cum Sulphathiozole	3 8	1 8
69. Atropine Cum Scopolamine	4 0	2 8
70. Calomel Cum Atropine	2 8	1 4
71. Sulphanilamide 10%, 20%	3 0	1 8
72. Shark-Liver Oil Cum Yellow Oxide of Mercury Shark-Liver Oil 20%	2 8	1 4
73. Shark-Liver Oil 30%	3 0	1 8
74. Dionine Cum Iodide	3 0	1 8
75. Tyrothricine Cum Sulphathiozole	5 0	2 8
76. Tyrothricine Cum Sulphadiazine	5 0	2 8
77. Penicillin Cum Yellow Oxide of Mercury	4 8	1 8


CONFIDENCE
The scrupulous choice of ingredients, careful processing, strict control and constant research have helped CIPLA to gain EQUAL WORLD STATUS in the production of pharmaceuticals.
The uniform good quality of its products have won for CIPLA full confidence of the public and the medical profession.
Use Cipla REMEDIES
CIPLA
Founded in 1935
Chemical, Industrial & Pharmaceutical Labs. Ltd., Bombay 8.

मसूरी
MUSSOORIE

यह पुस्तक निम्नांकित तारिख तक वापिस करनी है।
This book is to be returned on the date last stamped

दिनांक Date	उधारकर्ता की संख्या Borrower's No.	दिनांक Date	उधारकर्ता की संख्या Borrower's No.